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DEPARTMENTS OF VETERANS AFFAIRS AND
HOUSING AND URBAN DEVELOPMENT, AND
INDEPENDENT AGENCIES APPROPRIATIONS FOR
1994

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Departments of Veterans Affairs and...

ARINGS

BEFORE A

SUBCOMMITTEE OF THE
COMMITTEE ON APPROPRIATIONS
HOUSE OF REPRESENTATIVES
ONE HUNDRED THIRD CONGRESS
FIRST SESSION

SUBCOMMITTEE ON VA, HUD, AND INDEPENDENT AGENCIES

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Staff Assistants

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
FISCAL YEAR 1993 OVERSIGHT



JUN 27 1993

U.S. GOVERNMENT PRINTING OFFICE
SUPERINTENDENT OF DOCUMENTS

Printed for the use of the Committee on Appropriations

For sale by the U.S. Government Printing Office
Superintendent of Documents, Congressional Sales Office, Washington, DC 20402

ISBN 0-16-040746-X

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U.S. GOVERNMENT PRINTING OFFICE
WASHINGTON : 1993

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DEPARTMENTS OF VETERANS AFFAIRS AND HOUSING AND URBAN DEVELOPMENT, AND INDEPENDENT AGENCIES APPROPRIATIONS FOR 1994

WEDNESDAY, MARCH 17, 1993.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION FISCAL YEAR 1993 OVERSIGHT

WITNESSES

DANIEL S. GOLDIN, ADMINISTRATOR

GARY ALLISON, ACTING COMPTROLLER

LEN FISK, CHIEF SCIENTIST

JEREMIAH PEARSON, ASSOCIATE ADMINISTRATOR FOR SPACE FLIGHT

THOMAS UTSMAN, DEPUTY ASSOCIATE ADMINISTRATOR FOR SPACE
FLIGHT

CHARLES GUNN, DIRECTOR, EXPENDABLE LAUNCH VEHICLES OFFICE

ARNOLD D. ALDRICH, ASSOCIATE ADMINISTRATOR FOR SPACE SYSTEMS
DEVELOPMENT

HOWARD ROBINS, DEPUTY ASSOCIATE ADMINISTRATOR FOR SPACE
SYSTEMS DEVELOPMENT

RICHARD H. KOHRS, DIRECTOR, SPACE STATION FREEDOM, OFFICE OF
SPACE SYSTEMS DEVELOPMENT

DEIDRE LEE, ASSOCIATE ADMINISTRATOR FOR PROCUREMENT

CHAIRMAN'S OPENING REMARKS

Mr. STOKES. The committee will come to order. Mr. Goldin, I want to welcome you and those who are accompanying you here today for these hearings. I am going to begin with an opening statement after which I will recognize you for your opening statement and also afford you the opportunity at that time to introduce those who are accompanying you here at today's hearings.

I felt it was important to hold this hearing because the Appropriations Committee's responsibilities also include oversight and it goes without saying that the press has reported rather frequently recently on significant cost growth in a number of NASA programs, including the Space Station and the shuttle toilet.

I also hope you can understand how concerned we are that something at NASA is not working, when the GAO reports that more than 20 NASA programs have experienced a cost growth of 50 percent or more with some programs running at 250 percent above the initial cost estimate. So that is why we wanted to have this particular hearing to see if we can look at what needs to be fixed.

Based on what I have heard from the staff and others, let me open with a few general observations on what the problem might involve.

Actually, the GAO report offers some overall reasons suggested by NASA, which include the following: Inadequate definition studies, funding instability, overoptimism, contractor low balling, redesigns, technical problems, incomplete estimates, launch delays and so on.

Now, obviously all of these contribute to program overruns, but I believe that at the core of the problem is this point. For far too long both NASA and the Congress have tried to fund more programs than we can afford. And that fact coupled with an ongoing no-growth budget has become rather deadly.

I am also afraid that NASA and the Congress still want to keep alive everything that is on the plate. So what happens is that when a program is first defined and sold to NASA and then to OMB and then to the Congress, the tendency is to underestimate the risk and cost and even leave out of the RFPs major program requirements that are necessary if it has any hope of working.

What seems to happen, then, is a kind of charade. NASA signs a contract, let's say, with the ABC Aerospace Company. Both NASA and the contractor know that program X cannot possibly be built at the agreed price. But the NASA program proponents also know that if the contract carried the actual cost it might never clear the NASA, OMB and congressional funding hurdles.

How else can we explain the contract for the Advanced Turbopump being signed without a provision for all the necessary test hardware, let alone the flight hardware?

How else can we explain the ASRM contract being signed without any flight hardware? But it is also instructive that last year, even though we could only appropriate \$14.3 billion instead of the \$15 billion NASA requested, NASA or various Members of Congress still did not want us to kill a single program and all that does is cause delays and further drive up the cost. So the bottom line, so to speak, is that we keep on funding programs that we cannot afford, the space station being a prime example.

We keep starting programs that have in some cases an initial cost estimate that NASA knows is unworkable.

Now, I, of course, do want you to be able to respond to my observations and I understand that you have or are about to issue procurement regulations that will provide for a new fee structure that will improve the taxpayers' chances somewhat and we will be interested in hearing about that. If you are successful in getting it by the contractors, it will be a big improvement. But the problem I have been trying to describe won't be solved by new procurement regulations alone.

I think basically what I am talking about, Mr. Goldin, is up front honesty. What will this project really cost; having the discipline to admit that project X, Y, Z will cost more than a no-growth NASA budget can afford.

Before I turn it over to you, though, I want to make clear this hearing this morning is not intended as any NASA bashing. What this subcommittee is trying to do is shed a little light on what has

gone wrong and why. Today I think we have to first admit that there is a problem.

We have picked six projects that have incurred substantial cost growth for a variety of reasons. The six are the shuttle toilet, the Advanced Turbopump, Mars Observer, TOS, Space Station, and the ASRM. It will be my intention that we take up these programs in the order that I have just read them and I am going to ask the members of the subcommittee to confine their questions today to these programs and then in particular to the program that we have under discussion at the time. Also we provided everyone with a short synopsis of each program's history and the reasons for cost growth.

At this time, Mr. Goldin, I want to recognize you for your opening statement and we would like for you, if you will, to introduce those who have accompanied you here today and who would possibly testify at this hearing.

INTRODUCTION OF STAFF

Mr. GOLDIN. Thank you, Mr. Chairman. Let me start by introducing the NASA team. Gary Allison, the Acting NASA Comptroller; Deidre Lee is the Associate Administrator for Procurement; Dr. Len Fisk is the Chief Scientist; Jeremiah Pearson is the Associate Administrator for Space Flight; and Arnold D. Aldrich is the Associate Administrator for Space Systems Development. Howard Robins is also here; he worked on some of the management reforms we have. Dick Kohrs is the Program Manager of Space Station Freedom; and Thomas Utsman is Deputy Associate Administrator for Space Flight. Charles Gunn is Director of the Expendable Launch Vehicles Operations. Al Diaz is the Deputy Associate Administrator for Space Science and Applications and Michael Lyons is in the flight systems area.

Mr. STOKES. Thank you, I am pleased to have all of you with us.

Mr. GOLDIN. Before I go forward with my prepared comments, I would like to say, Mr. Chairman, that NASA does not disagree with some of the issues you have brought up in your opening statement. I think in a period of constrained budgets, restraint and openness are the key to a successful future to NASA.

You pointed out that some of the programs we are looking at today have spanned as many as four Presidential terms and four NASA Administrators; many of these programs started at a time of budget growth and have transitioned into a time of flat budgets. These programs are making this transition from one economy to another economy, another approach where I think the wheels of the train may have come off the track.

Let me make some formal statements and then I will be prepared for questioning. We view this hearing as very positive. We believe that this hearing will help NASA do a better job and we look forward to it.

Mr. STOKES. Thank you.

MR. GOLDIN'S OPENING REMARKS

Mr. GOLDIN. Thank you, Mr. Chairman for inviting us here today to talk about problems, and hopefully solutions, with respect to cost

growth on NASA programs. The problems need to be put in perspective. NASA and our industry team are made up of outstanding people. They are dedicated, hard-working and want to insure that NASA's programs are successful. These outstanding individuals have not failed in their quest; in many instances, our aging management and procurement systems have failed to support them in times of change. We should devote our energies to resolving this basic issue if we are to enable them to be successful in these endeavors that are so critical to the country's future.

Cost growth is complex. The reasons for it range from program funding instability and unrealistic contractor proposals, to NASA overoptimism, to changes in launch vehicles or upper stage, or to diffuse management without accountability and unconstrained requirements growth.

In spite of a variety of reasons for cost growth and the fact that some factors leading to it are not fully in NASA's control, we in NASA take full responsibility for the successful design and execution of the Nation's civil space and aeronautics program.

NASA's employees across the Agency at all levels over the last nine months have participated in what we call the "Red and Blue" team exercises and institutional reviews. What we did was form teams of people that were advocates for programs and people that were not part of the program to get objective sets of views to try and see how we could do our job better. And literally hundreds of employees across the agency identified deficiencies in our management and procurement systems. These employees have also identified solutions which are the basis for a number of the reforms we are going to outline today.

MANAGEMENT REFORMS

These reforms we will outline are not easy. They will require time to test, to implement, and they will require vigilant application and support from within NASA, the Congress, and the White House. Once we set the reforms into place, we have to have the fortitude to stick with them and not back off. That is very, very key, and you will see some of that in the testimony today.

Mr. Chairman, we believe this hearing is an excellent forum in which to examine the causes for a program cost growth and to present our initial cut in management and procurement reforms. We actively solicit the views of this Committee with respect to those reforms and any additional suggestions you might have.

There are more details relative to the reforms in my testimony. But what I would like to do today is to explain how, when we implement these reforms, we will do it, starting with the program definition all the way through program launch. I would also like to indicate some examples of how the reforms might have impacted some of the programs we are discussing today.

PROGRAM/PROJECT PLANNING

Let me say a program starts with proper planning; and the most key element of proper planning we could undertake is requirements definition. There has been a tendency at NASA, and we accept responsibility, to start programs too soon; we don't expend

the necessary funds up front to define the requirements, and we get into the program where we have large numbers of contractors and NASA employees involved. That is where we have problems. If one looks at the Waste Collection System (WCS), the requirements were not clearly defined with that contractor. The RFP was released prior to fully defining the requirements; as a result we didn't get a complete contract definition and we had cost growth because we didn't have fully defined requirements.

Overoptimism is also a problem. A major area of concern is properly reducing the technical risk to an acceptable level before we go out with a major procurement so that we have a clear understanding, and to spend the time and money up front when we have competition going on to get the very best out of our contractors. It is the assessment of our team that on the Alternate Turbopump had we spent twice the amount of money up front and taken the time up front to relieve the technical risk, we might not have had the problems we had. So, again, we in NASA must be willing to say, "no, we will not proceed" if we can't get the adequate funds up front to get a program started, rather than saying we want to get the program started and will accept lesser money to do the definition. This, to us, is absolutely essential. We accept the responsibility at NASA and we have to be able to say "no," when we can't get proper allocation in the OMB or the Congress and we have to have that restraint. It is crucial that we do that and we have a process for defining it.

We also have to have proper contingency planning up front. Because we generally fund programs when they start at very low levels, we don't have room for contingency planning and parallel paths. Later, when we get into trouble, there is money available for parallel paths processing, but later in the program time is an enemy, not a friend. Because we don't have time to solve problems later in the program as we just have on the Alternate Turbopump, it costs extra money.

So, again, we say we should define what we need up front. If we can't get the resources up front, we must have the restraint to say we can't proceed, and will start some other program or wait until we have funds available. It is crucial.

Another aspect that we must have is what we call a "red/blue" cost analysis. We cannot just have the program that is an advocate of getting a project started coming up with costs. Right at the initiation of a program, we must have an independent cost assessment to validate the program costs. And as you so aptly pointed out, we must have life cycle costing. It is not acceptable for NASA to go forward with just development costs; but we must give the White House and the Congress a clear view of the operations costs, the production costs, the maintenance costs so that, later on in the program, there aren't surprises.

And we at NASA have to be prepared to say if we are going to show the big number and we can't get the program going, it is okay. It is okay.

PROGRAM MANAGEMENT COUNCIL

Finally, we have to set up a process within NASA where we can have a review authority for approval to proceed. As you will see in our formal testimony we submitted, we are proposing setting up a Program Management Council made up of the Center Directors and the Program Associate Administrators. All these issues would be brought forward to the Council and we would have a go/no-go decision before we even go forward to the White House and the Congress. So we must meet criteria before proceeding; and we must have adequate funding for the initial definition and that is probably the most important thing we can do.

The second point involves the program start-up. We must have clear delegation of authority and accountability, and we can't have diffuse management. And on a number of the programs we have not had that.

With regard to performance and procurement, we must incentivize our contractors to perform and not just win the contracts. To do this we have to have the appropriate contract type; in some cases it is appropriate to have a fixed-price type contract and in other cases cost type contract is appropriate. But most importantly, we believe at NASA that we should measure the contractors on the end product-performance—does it work on orbit? Did it come in within cost and schedule?—and not on interim progress. So, we are proposing in our procurement reforms that we go to a provisional fee and that the fee not be earned until the contract is complete and we see where we are.

And, at the end of the contract, if the contractor has performed, they deserve to have a significant fee. If they have not performed, we are proposing that in certain cases all fee be turned back to the Government and, in other cases, that negative fee be paid. And we will be pleased to outline those to you as we go along here. But provisional fee is crucial because then contractors will understand you can't just bid to win. There is a consequence of low balling and that consequence could be loss of complete profit or even losing profit on a contract.

Another thing that we have to make clear to our contractors is that when we award contracts, those procurements will be awarded based upon prior performance in addition to future promises. There must be a balance and we can't go on saying everything will be okay if a contractor hasn't performed over the years.

There is another issue we have to deal with in the NASA procurement system. Because we do not have a process where we can correct deficiencies before negotiation, we are selecting contractors with known deficiencies and proposals so after the contract is awarded the deficiencies and the base price goes up from the bid. That, too, must be worked through. Given that we have those first three reforms, we must have proper training in the systems we are executing for the contractors and the NASA personnel.

Once the contract gets started we must baseline that contract. We must have metrics to measure NASA and the contractors and we must look back and forward. Here is what I mean. Starting this year we are going to have Program Commitment Agreements. Those are contracts between myself and each of the Program Asso-

ciate Administrators which clearly define what that contract is at the start of the year, and we will measure the Associate Administrator's and NASA's performance as to how well they are monitoring and controlling requirements growth.

In addition to that, we will measure the contractors and see how well they are performing and this data will be available for us to see and measure as we go through each year. That is looking backwards, but looking forward is almost as important. We do not have a system in place at NASA which gives us early warning signals of problems. So we are committed to setting up, and are in the process of setting up, an independent cost assessment team and we are staffing it up to the proper levels. This team will be in place from the day we have a concept idea for a program all the way through launch and operations.

In parallel with that, as we look forward in projecting what the costs are going to be, we are going to have a much better contract forecasting system. The IG has sent me a recommendation that our present 533 contractor reporting system does not give us a proper set of measurements so that we can understand the optimism or conservatism in those numbers. We will require and train our contractors to put their assumptions right on the front so we will know whether there is schedule slack in the plan. We will know whether assessments on drawing counts are correct; we will know whether they are optimistic assumptions so we can get some basis of understanding on whether we are going to have overrun or underdun in the contract. Those are very essential.

Finally, based upon those measurements, we are planning a "yellow light" trigger system. When we see an indication of a problem it will come to the Program Management Council where we will have to make a decision as to whether to terminate or rebaseline a program. I want to repeat that. NASA has to have the ability to make a decision to terminate or rebaseline a program if it looks like it is going out of control. And this could happen for a couple of reasons.

First, requirements growth. That would be a NASA-induced problem. Second, overrun from a contractor, and, third, major program changes. If you take a look at the Mars Observer as an example, that started out as a low-cost multiple spacecraft program that shifted into a one-spacecraft program. It started out at a low cost and had we had this "yellow light" system we could have made a decision.

Another example is the Transfer Orbital Stage, which started out at \$30 million and ended up at \$200 million, and the requirements kept changing. It started out as a commercial system on the shuttle before Challenger. That did not have the safety requirements. As we went through Challenger we upgraded safety elements and made it a different machine; then, we put it on a commercial launch system. Had we had this trigger system, we could have made a decision after spending tens of millions to go a different way. Again, coming to the Program Management Council with independent cost assessments is essential to dealing with the issues.

Finally, two years and one year before the launch of any major spacecraft program we intend to have a Mission Review to establish the validity of that program.

Mr. Chairman, the NASA team before you is prepared to commit to the following. We will not bring programs forward to the Congress or the White House for development which have not been fully defined.

We will terminate contracts for cause.

We will implement a revised award fee policy which will require a return of fee by contractors whose products and procurement plans do not meet stated objectives.

We will not allow requirements to grow so that we build gold-plated systems or allow contractors to "get well."

We will deliver programs relevant to the American people.

I believe that each of the senior managers before you has specific "lessons learned" on the programs we will discuss today.

I hope the Committee will give them an opportunity to outline those observations and their views as to the importance of the management and procurement remedies which we have generated by the employees across NASA.

Mr. Chairman, the cost growth in the NASA programs we will discuss today represents, to a large extent, history. While we cannot rewrite that history, we must understand it if we are to improve our future program management. With this in mind, we are moving forward with a series of reforms and are committed to their successful implementations. We must provide our people with the best tools we can.

When proven in pilot programs, we expect the reforms we have proposed today will do just that, but in the final analysis, however, we will be judged not only on the reforms we put in place, but on how well we execute our programs.

We solicit your advice on these or any additional measures we might take. The Congress and the American people deserve fiscally responsible management of the Nation's civil space and aeronautics programs.

It is the intent of the entire NASA team to be good stewards of that program. I remain very proud of that team and the dedication they have given to the American public over the last decades. I am confident they will continue to merit your respect in the decades to come.

I will be pleased to respond to any questions you may have at this time. Thank you very much.

[The information follows:]

HOLD FOR RELEASE UNTIL
PRESENTED BY WITNESS
MARCH 17, 1993

Statement of
Mr. Daniel S. Goldin
Administrator
National Aeronautics and Space Administration

before the
Subcommittee on VA, HUD, and Independent Agencies
Committee on Appropriations
United States House of Representatives

We have come here today to talk about problems and hopefully, solutions, with respect to cost growth in NASA programs. The problems need to be put in perspective. NASA and our industry team are made up of outstanding people. They are dedicated, hard working, and want to ensure that NASA's programs are successful. These outstanding individuals have not failed in their quest; in some instances, our aging systems have failed to support them in times of change. We must devote our energies to resolving this basic issue if we are to enable them to be successful in these endeavors that are so critical to this country's future.

This past December, the General Accounting Office published a report on NASA Program Costs. Data was collected from 29 programs. Almost all of the 29 programs reviewed required substantially more funding than the initial estimates provided to Congress. Changes in estimates ranged from a 44-percent decrease to a 426-percent increase over the initial estimates, for a variety of reasons. To cite only a few programs, Mars Observer showed an 85-percent increase, the Advanced Solid Rocket Motor a 91-percent increase and the Alternate Turbopumps a 183-percent increase. Out of the 29 programs reviewed, the average delay for the 12 programs launched was nearly 4 years, 44 months.

I could discuss in detail why these problems occurred and cite such reasons as program and funding instability, unrealistic contractor proposals and estimates, and over optimism. There are valid reasons for increases in certain estimates. It should be recognized that estimates increased, for a number of the programs cited in the GAO report, as a result of the Challenger accident. The accident caused some missions to be delayed by several years. Other program estimates had to be changed because the spacecraft were taken off the Shuttle and launched on expendable launch vehicles. Others were affected by the decision to replace the liquid fueled upper stage propulsion system with a solid-fueled system. In some instances, I believe, growth occurred because program responsibility and accountability were not sufficiently clear.

But when all is said and done, clearly, the responsibility and accountability is ours. The American public looks to NASA to implement and manage civil space and aeronautics programs. It has been well said that responsibility is a unique concept. It can only reside and inhere in a single individual. One may share it with others, but one's portion is not diminished. One may disclaim it, but one cannot divest himself or herself of it. Even if one does not recognize it or admit its presence, he or she cannot escape it. If responsibility is rightfully one's own, no evasion or ignorance, or passing the blame can shift the burden to someone else.

This past week, I announced a major reorganization at NASA that I feel will not only streamline the management of our major programs but improve and shorten the decision process. Mission to Planet Earth, Planetary Science and Astrophysics, and Life and Microgravity Sciences and Application now report directly to the Administrator. Rather than having billion dollar programs managed at the division level within a large organization, we now have the decision process, the responsibility and the accountability clearly established -- a first step, but we have a long way to go.

Last summer we initiated an intensive internal NASA review with "Red and Blue" teams and institutional teams looking at all our programs, as well as how the Agency does its business. The Red and Blue teams identified areas of significant cost savings. In a similar fashion, they and the institutional teams identified a number of weaknesses in existing program management and procurement practices that have contributed to the problem we are here to discuss today. Their efforts have in turn, identified remedies that are the basis for the reforms I will discuss today.

In this era of fiscal austerity and the attending emphasis on maximizing the return on investment of each federal dollar, program control and procurement activities must be streamlined and improved. We must try to provide our people with the best tools we can, but, in the final analysis, we will be judged not only on the reforms we put in place, but on how well we execute our programs.

Let me state, Mr. Chairman, the sources of cost growth in NASA programs are complex. These problems will demand remedies which are not easily identified and implemented; otherwise, such remedies would already be in place. Many of the procurement and management challenges which face NASA are confronted Government-wide. Some reforms will involve regulatory changes; perhaps, ultimately, statutory measures will be needed. However, we are taking deliberate steps now to institute a number of significant reforms, which are outlined below. These changes come from all levels and from all across NASA and take advantage of the experience and best judgement of those individuals who must

implement our programs. Mr. Chairman, I believe this hearing is an excellent forum to openly discuss issues surrounding cost growth. I look forward to the Committee's review of our reform measures; we also stand ready to listen to recommendations which the Committee may have.

MANAGEMENT REFORM

Program/Project Planning

Important policy changes in support of improved program/project planning are being undertaken. These measures are designed to ensure that commitments are met, and that NASA has a full understanding of requirements before initiation of the final design and fabrication phases, and that requirements are firmly set prior to initiating of these phases. Towards this end, we would like the help of this Committee so that we might fund future concept design studies more robustly. By achieving a full understanding of the original requirements and preventing their growth during design and fabrication, the need to make changes in the program baseline and contract can be minimized and cost increases can be accommodated within program reserves.

Program Commitment Agreements

Program Commitment Agreements (PCA's) are being established for all significant NASA programs and projects. PCA's are two-way agreements between the NASA Administrator and the Program Associate Administrator, which define the program objectives, areas of exceptional risk, internal NASA agreements, external agreements, and commitments (including resources and technical and schedule milestones). These definitions form the boundary conditions and assumptions for major programs and projects, and identify and commit all parties to the agreement.

Program Management Council

A Senior Program Management Council chaired by the Deputy Administrator with senior Headquarters and Center Director membership is also being established. The Council will provide an Agency-level forum for addressing strategic planning, go-ahead approvals, and implementation for all major Agency programs. It will assure that the Agency functions as an integrated system in planning its mission to meet its commitments within available resources.

Independent Cost Estimating

In order to strengthen cost estimating, independent estimates will be reported for major programs, by the Office of the Comptroller to the Deputy Administrator for review

and reconciliation with program office estimates. Oversight is expected to substantially increase as the Agency increases the depth and frequency of required reviews. NASA's Cost and Economic Analysis Branch is actively seeking additional, qualified staff for the expected workload. By providing NASA management with independent estimates throughout the entire life of a project, this function should enhance the Agency's fiscal controls and ability to respond to changes in a more informed and rapid manner. By minimizing surprise, program stability will improve and the potential for cost and schedule growth will be reduced.

Contractor Reporting

During the past several months, NASA has conducted an in-depth review of the methodology for analyzing contractor-reported costs on major supply and services contracts. The review team validated the concept of cost reporting noting that when the data received from the contractor is complete, accurate, on-time and properly structured, the NASA Financial Management Reports (NASA Form 533) should meet the needs of the project, financial and procurement managers as a cost performance management tool.

There were, however, several problem areas noted in the report. There is a lack of understanding of the roles and missions of many participants in the NASA Form 533 process that can degrade the usefulness of the report, some NASA contractors do not have a clear understanding of their roles and responsibilities with regard to submission of financial and program control data, and, there is a need for training of the developers and users of the report data to assure appropriate structure, depth and usefulness of the data.

NASA has established a program that will define the organizational alignment and accountability necessary to effectively manage the financial performance of NASA contracts. Additionally, training programs are being developed for government and contractor personnel that will assure consistent financial reporting and analysis is completed in a timely manner. The NASA Contractor Finance and Accounting Branch has been tasked with assuring that personnel are adequately trained, that contractor reports comply with governmental standards, and that NASA personnel use the best techniques to review and report contractor progress to program management. This task is being accomplished through systematic training and audits of work products at NASA Headquarters and Field Centers.

In addition, the contractors will be required to indicate on their "533" submittals the assumptions that were used in formulating the report. These will include such factors as

schedule margins assumed, drawing preparation and testing time, time allocated for replacement of critical components, and other assumptions essential to ensuring the credibility of the submittals.

Mission Reviews

In January 1993, an independent, external review of the Hubble Repair Mission was initiated. This is the first step in standardizing mission reviews at intervals of two years and one year prior to launch for all NASA programs which meet the funding threshold for submission of a Program Status Report to Congress. These reviews will be tailored to the mission-critical elements, focusing on the adequacy of hardware and software, detailed operations, and processing.

Metrics Process Action Team

A Metrics Process Action Team (MPAT) has been formed to develop an Agency-wide measurement system that will support senior managers and the entire NASA team in evaluating performance and improving processes. The MPAT has members from all major functional offices, programs, and representative field centers. The purpose of the NASA-wide metrics program is to identify key performance measures and establish a "corporate" tracking system for these measures. The MPAT has identified ten areas for NASA-wide measurement and established procedures for collecting, analyzing, and reporting data. An internal pilot program will test the validity, relevance, and effectiveness of the metrics.

PROCUREMENT REFORM

In support of NASA's management reform initiatives, a series of concurrent procurement reforms are being undertaken.

Incentive Contracting

Approximately 76% of NASA's contract dollars are obligated on Award Fee Contracts. These contracts have traditionally been a preferred contract type, allowing close interchange and involvement by NASA technical personnel with their contractor counterparts. However, recent NASA programs managed under Award Fee Contracts have come under public scrutiny which has highlighted the fact that, while Cost Plus Award Fee (CPA) contracting offers great benefits, there is also substantial room for improvement. An intensive internal NASA review has been conducted which has identified numerous weaknesses, including:

- too much emphasis on interim progress; too little on end products;
- fees too often earned before the results are seen;

- too little emphasis on cost;
- perception by evaluators that ratings of contractors are self-evaluations, with result that ratings are not objective evaluations of actual contractor performance;
- needless inconsistency among the Centers;
- poor communication with contractors;
- inadequate training of participants;
- perception by industry that ratings and fee payments take too long; and
- perception by Government personnel that the administrative process is too burdensome.

As a result of these reviews, and in response to concerns by the NASA Administrator and Congress about "contractor performance," NASA policy on incentive contracting is undergoing a vigorous restructuring. First, emphasis on selection of the appropriate type of contract, considering end product, contractor risk, technical unknowns, cost uncertainties and other key factors, is paramount. When an Award Fee contract is determined to be appropriate, performance incentives must be encouraged, with emphasis on the end product delivery and performance rather than interim progress.

A new NASA Incentive Contracting (Award Fee) policy has been developed and will be tested beginning this year. The policy includes parameters for award fee negotiation and includes opportunities for contractors to earn higher than "normal" NASA fees, yet emphasizes cost and technical performance through the use of clarified award fee procedures. The policy provides uniform scoring categories throughout the Agency, emphasizes timely payment of interim earned award fees, and includes significant financial penalties under certain non-performance circumstances. The policy has been reviewed by industry trade associations and the NASA Industry Process Action Team. Currently it is NASA's intent to implement the Award Fee policy on new procurements and to monitor progress and implement improvements as necessary during the 1993-1996 test period.

Parallel Negotiation of Contracts

NASA's current process in Source Selection is to select an "apparent" successful offeror and then negotiate the final contract with that one offeror. NASA is exploring a method for the Source Selection Official to select a successful contractor after negotiation of final contracts with all offerors in the competitive range. NASA plans to test this approach on selected procurements to determine the benefits and problems of such an approach in supporting cost realism, negotiation effort and process time. The results of this test will be reviewed and evaluated at the end of 1993.

Contract Management Improvement

Contract administration has been identified as an Agency material weakness under provisions of the Federal Managers Financial Integrity Act. A multifaceted program of corrective action has been developed, the implementation of which is expected to require an extended period of time to address the problem, which has the following features:

- improved subcontract pricing and management;
- more effective utilization of contract administration services obtained from Department of Defense;
- increased Headquarters management focus through the establishment of a Procurement Contract Management Division;
- allocation of additional personnel to the contracting management function at Headquarters and the Field Centers; and,
- an Agency-wide training program in contract and subcontract management.

Contractor Metrics

I have directed that an effective reporting system be established to provide an overview of Government/Contractor performance on key NASA programs. As lead on this team, the Procurement representatives, working with Headquarters Technical Offices, Center and Industry representatives, developed a metrics reporting process. Using existing data, appropriately staffed through the Program Offices, NASA's 30 largest contracts will be semiannually reviewed to measure progress in key areas including cost control and technical performance.

The system will also reflect requirements and cost growth generated by the NASA program changes. In conjunction with the Program/Project Management improvement initiative, these metrics will help identify contracts which should be reviewed for performance problems and consideration for cancellation. Four contracts have been identified as test cases and the first report on these contracts are currently being evaluated. Based upon the data usefulness with appropriate clarifications, it is anticipated the first full report on the top 30 contracts will be completed by the end of 1993.

Mid-Range Procurement (Pilot Test Program)

Under the Federal Acquisition Regulations there are in essence two classes of procurement: "small" purchases (less than \$25,000) and "large" purchases (greater than \$25,000). Small purchases are accomplished relatively quickly, with limited paperwork and processing time. Large purchases are subject to extensive requirements, including lengthy solicitation Requests for Proposal documents, adding time and cost to the processes.

In initiating the Mid-Range procurement initiative, it is NASA's intent to develop a third category of procurement--those between \$25,000 and \$500,000. The reform would limit the documentation requirements and the length of the contract itself, thereby shortening the procurement process and making it easier and less costly for small businesses to participate in Government procurement. These procurements would be set aside for small business. The reform also includes use of electronic bulletin boards to shorten the publication time for such procurements. To enact such changes in a pilot test program requires statutory authority, which was not granted during the 102nd Congress. NASA is currently working with the Office of Federal Procurement Policy (OFPP) to conduct a pilot test program at one NASA Center beginning this spring 1993.

Grants Process Improvement

An early success in procurement reform, the NASA grants process, was evaluated by the primary technical offices and a small team of procurement professionals in the fall of 1991. At that time the contracts office had a backlog of over 500 grants and was taking an average of 103 days to process an action. Through NASA internal process changes, the backlog was eliminated and the grant award process streamlined so that grant awards now average 13 days.

Small Disadvantaged Business (SDB) Program

NASA has a commitment to award 8% of its contract dollars to Small Disadvantaged Business by FY 1994. To meet this commitment, NASA Procurement has teamed with the NASA Small Business Office in identifying ways in which SDB contracting can be encouraged. This reform activity has encompassed a spectrum of activities including clarification of contractor reporting procedures and frequency, to working with the NASA technical offices to provide them with current data on their SDB prime and subcontract activities.

A Determination and Finding allowing NASA to set aside identified procurements for SDB's has been signed and the new acquisitions are in progress. NASA program and

procurement offices are more carefully screening their requirements to identify SDB opportunities in prime contracts as well as setting tough goals for subcontracting.

This reform has already reaped benefits. The FY 1992 contract dollars for SDB's totalled 7.2% of total contract dollars and it is projected that the 8% goal will be met in FY 1994. In conjunction with the 8% goal, the Small Business Office has initiated numerous activities, including more outreach and customer orientation, to assist in identifying qualified SDB's and increase the technical competency of such businesses.

Mr. Chairman, the cost growth in the NASA programs we will discuss today represents, to a large extent, history. While we cannot rewrite that history, we must understand it if we are to improve our future project management. With this in mind, we are moving forward with a series of reforms, and are committed to their successful implementation. We solicit your advice on these and any additional measures we might take. The Congress and the American people deserve fiscally responsible management of the Nation's civil space and aeronautics programs. It is the intent of the entire NASA team to be good stewards of those programs. I remain very proud of that team, and the dedication they have demonstrated to the American public over the past decades, and am confident they will continue to merit your respect in the decades to come. I would be pleased to respond to any questions you may have.

SPACE STATION PHASE B DEFINITION

Mr. STOKES. Thank you very much, Mr. Goldin. Let me just say at the outset before I begin my questions, I very much appreciate the very candid and forthright manner in which you have made your presentation here this morning, and the responsive manner in which you have responded to some of the concerns that we have raised with you. You have enumerated for us a number of reforms which we will be interested in perhaps asking some questions about. But it is indicative of the fact that you have obviously given a great deal of serious thought and attention to these concerns and I appreciate that.

Now, I also want to agree with you about having sufficient upfront money for definition, and that would cause me to want to ask you about the space station. I understand in the case of the space station, NASA had considerable resources for the phase B activity and then that money was largely misspent.

Can you tell us how much did NASA spend on station phase B definition?

Mr. GOLDIN. I don't remember the exact number, but my recollection is somewhere on the order of \$500 million and I would have to ask Dick Kohrs.

Mr. KOHRS. The exact number is \$596 million.

Mr. STOKES. Is it correct that virtually no specifications were completed in phase B?

Mr. GOLDIN. Dick, could you help with that.

Mr. STOKES. Mr. Kohrs has the history of that.

Mr. KOHRS. With a little bit of background, we did spend \$596 million up through 1985, 1986 and 1987 until the contracts were awarded. It was offset somewhat by the Challenger accident. We were trying to get the program kicked off in 1986 because of the Challenger accident. We continued to do phase A and phase B and to develop the RFPs that were issued to the contractors, I believe, in early 1987.

We did have what you referred to as a specification or an RFP. Now, the question is whether it was adequate or incomplete. I think, as the program went on, we added requirements that reflected either changes that we made or changes in the budget profile. But the answer is that we did have a specification. It probably was not totally complete; we did spend the \$596 million, and it was offset somewhat by the Challenger accident because we delayed the start of the program.

Mr. STOKES. I guess the question, then, is can you really justify the expenditure of the \$596 million under those circumstances?

Mr. KOHRS. I think in retrospect we were prepared to proceed in 1986 with Phase C-D contracts, which is the development phase. We kept the team together while we were recovering from the accident and to keep that team together, we spent money on developing RFPs. We spent money on test beds. We developed test beds for the technology for the environmental control system at Marshall, for the propulsion system at Johnson, and for the electrical power system at Lewis. So we did spend money on technology development as we were waiting to get into the contract awards and that

is money that was spent more on civil service efforts than it was with the prime contractors.

Mr. STOKES. Was the RFP adequately prepared, would you say?

Mr. KOHRS. If you go back to 1986 and the people that developed it, the people involved there would say, yes. As you look back six or seven years later, and how we have changed the Space Station, we have had some deficiencies. It is clear that, here again, we could have built a better specification, knowing what we know today. That is the way I would classify it.

NEW FEE PROVISION

Mr. STOKES. Let me get back to Mr. Goldin. Thank you, Mr. Kohrs.

When do you believe you will have the new fee structure in place that you testified about?

Mr. GOLDIN. We have submitted it to OFPP for approval to be released in the Federal Register. We believe it will be released in early April.

Ms. LEE. Yes.

Mr. GOLDIN. How long will that process take?

Ms. LEE. In the initial release, we will get in public comments. It will be out for about 30 days for comment. We will review those comments, validate, coordinate and individually disposition them, and then we will publish in trial form. So we are probably talking about the summer timeframe for that.

We are, however, beginning to implement parts of that award fee policy in new contracts as they come up, those that don't need separate approval or change.

Mr. STOKES. Mr. Goldin, you talked about the reform. Let me ask you about the Hubble mirror problem. You will recall that my predecessor, Chairman Traxler, asked NASA if the Hubble contract contained any kind of a warranty, any kind of contractor liability. The language that NASA gave the committee was really, very frankly, very shocking.

I want to read that language to you. It said, "Except as provided in this clause, and the exception is fraud, lack of good faith or willful misconduct, except as provided in this clause and as may be provided in the schedule, the contractor shall have no obligation or liability to correct or replace articles which at the time of delivery are defective in material, or workmanship, or for any other reason not in conformity with the requirements of this contract."

Now, in the case of Hubble, apparently there may have been some fraud. As you know, this issue is now with the Justice Department. But the point is, NASA's standard contract language seems to suggest that the contractor can deliver virtually any product, and even if it doesn't work, he will still get paid.

Also, as I understand it, when this committee attempted to have this language set aside and let NASA come up with an alternative, we were strongly opposed by your general counsel who suggested that this was government-wide contract language and he urged us not to make an effort to fix what we perceived to be a problem.

So the question is, do the changes you are about to promulgate in the Federal Register fix this language?

Mr. GOLDIN. The answer is I believe it meets the intent of changing that language in the sense that a contractor, like the Hubble contractor, if it did not perform, would lose its entire fee that was earned. They wouldn't earn a nickel of profit. That was not the case before and that is because it was a one-of-a-kind contract.

On a production contract not only would the contractor lose the fee, but they would lose the maximum fee that they could have earned. So, for example, if it was a contract where there was a 15 percent maximum earn fee potential and they only earned 7 percent, not only would they have to give back the 7 percent that they earned to NASA, but they would also have to give back an additional 8 percent, so they would have to pay NASA negative fee.

I believe that that meets the intention of what the Committee had been talking about. I don't know how we would change that language, but we ought to go take a look at that. This new fee provision, I think, meets the intent of what the Committee was asking for.

NEW PROGRAM STARTS

Mr. STOKES. I have one other general question, then I am going to open it for other members of the Committee for general questions.

We have not seen many NASA new starts in the past two or three years, partly because of the impact of the station and partly because of the overall budget crisis, but I venture your prediction in the 1994 budget might have one or two new starts because I think we both agree that the overrun will not be fixed unless it is fixed up front, as we have already discussed, in the initial estimate and the RFP.

The question is, if we can find the money to fund any new program, that program cannot start, in other words the RFP cannot be released until the Committee gets an independent cost analysis from GAO or CBO?

Let's say, after a 30 or 60-day independent look at those numbers everything seems relatively okay, then NASA could proceed. Does this sound like something that would be logical and reasonable or something that you would be willing to take a look at?

Mr. GOLDIN. Let me say we think it is very important to have the trust and understanding of Congress and we in NASA have to be willing to put our proposals to the scrutiny that the Congress would give to us, to convince the Congress we are going in the right direction. If we have a valid process, as I have outlined, it should meet the scrutiny of outside assessment and we would be prepared to stand up to it.

Mr. STOKES. Thank you very much.

Mr. Lewis, I recognize you.

NASA'S CONTRACT MANAGEMENT DIFFICULTIES

Mr. LEWIS. Thank you, Mr. Chairman.

Welcome, Mr. Goldin. I have approached this hearing with no small amount of trepidation because I find myself very concerned about making certain that a foundation is laid as these discussions

go forward so that we can continue to have the kind of bipartisan support we have for NASA programs on the Floor.

There has been, as we discussed many times, an astonishing level of support for NASA in spite of these difficulties. I think the public sees that vision that NASA is all about and desperately wants to continue supporting that work.

I don't use GAO as my source for all discussions, but in December, as the Chairman mentioned, the GAO released a series of reports identifying 17 separate Federal programs which showed high risk for scandal. Unfortunately, NASA's contract management procedures were described as one of 17 programs. The GAO concludes that one of the specific causes of NASA's contract management difficulties is, and I quote, "that NASA does not clearly differentiate between the programs that it must do and the programs that it should do. The resulting budget planning mismatch means that NASA perpetuates resource shortaging subjecting its programs to a recurring annual cycle of cutbacks."

My office receives any number of newsletters and publications such as Space News. Occasionally, these publications also contain comments from NASA officials and employees which might lead one to believe that NASA's funding problems are almost exclusively the result of congressional micromanagement and underfunding of programs.

To begin with, I am really quite interested in your comments about the causes of this budget planning mismatch. Do you agree at all with the GAO's assessment regarding NASA's failure to prioritize?

Mr. GOLDIN. Let me start by saying I think it is an unfair statement for NASA to say that our problems are due totally to micromanagement. That is not a fair statement. Anyone in NASA is free to talk to the press, and I think it would be inappropriate for the Administrator to tell employees what to say and what not to say. But this Administrator does not believe that NASA's problems stem solely from micromanagement from the Congress. I don't think that that is a valid statement. We have a lot that we control and we have to be prepared to take control of what we control and I will come back to a statement I made in the beginning. If the Congress does not allocate adequate resources to NASA to perform a program, we have to be ready to stand up and say these are not adequate resources based upon our analysis and we can't proceed. And that should precipitate a discussion that should take place. So that is the first statement I want to make. The second statement, I lost part of your question, I am sorry. Could you state it again?

Mr. LEWIS. I guess I was pursuing your reaction to micromanagement initially and I believe you have addressed that rather directly.

Mr. GOLDIN. Clearly there is a give and take. There are a broad range of issues. Let me also add that I believe one of a number of issues we have is, when the budget starts getting squeezed, we try to reduce the cost of all our programs and stretch them out, rather than face up to some terminations, as the Chairman has talked about. That leads to problems, we in NASA can't just say the Congress reduced our budgets and therefore that is the cause of the problem. In part it is; but NASA must come back and say these are

not legitimate funding levels and maybe we should consider termination at some point in time.

FUNDING RESERVES

Mr. LEWIS. As we go forward with these discussions today perhaps you can provide more elaboration on the success or failure of your blue-red team discussions.

Mr. GOLDIN. Sure.

Mr. LEWIS. The six programs we are discussing today involve highly complicated technologies. When the Associate Administrator testified in front of the authorizers earlier this month, he specified that the R&D funding for each major program is budgeted to include reserves. These reserves are included to cover the possible technical challenges, problems, and unforeseen cost growth.

For the record, could you help this Member understand the process by which NASA calculates reserve funding?

Mr. GOLDIN. We have a review that is going on right now, but let me say one thing right here. Reserve is a number that is put into the legitimate program funding that NASA goes forward with due to the very nature of our work, as you said. The problem we have had, I think, is NASA's responsiveness to the Congress; when we have budget problems, we have attempted to resolve those budget problems by taking the reserve out of the in-years, and pushing it to the out-years.

Now, the place that you need reserve in the program is not at the end of the program when there is maximum certainty, but at the front of the program where there is maximum chaos, when you have problems. If there is one thing we have got to do better at NASA, I think we have a reasonable system in place for establishing reserves; but we have got to properly time spread those reserves. We should have the maximum reserve before the preliminary design review.

When you get to critical design review, you have to allocate reserves, and leave some in the outyears; but it should be a narrowing-down function not a building-up ramp. And I think that is the major issue we have to face up to. So, as part of the process we are undergoing now we have asked the directors and program associate administrators to review the historical record of how we spend reserves, and then play that against what we are doing. So we don't have a complete answer right now, but that is the overall approach I think we have to take.

Mr. LEWIS. What would you say would be the baseline for adequate reserves in any of the six programs that we are discussing today, 30 percent?

Mr. GOLDIN. I do not know. Let me say the following: If you don't have adequate definition of requirements, if you don't have contractors motivated to perform instead of just winning, if you don't have a system in place that can control requirements growth, there is no amount of reserve that you can put in to protect the program. So given that you execute the proper reforms that we talked about, I then think it is appropriate to apply reserves, but you can't apply reserves if you have tremendous uncertainty. How can I apply a re-

serve if I just have development costs and I don't include production costs?

Mr. LEWIS. When we are proposing so many programs, there is, to say the least, an endless requirement for funding.

Mr. GOLDIN. Take a high technology program like the—I will just pick a program and I will give you a set of assumptions and—

Mr. LEWIS. Like turbopumps.

Mr. GOLDIN. Alternate Turbopump. Had we done the things we had outlined in my opening testimony and thoroughly worked them through, I would say that an adequate reserve might be on the order of 20 to 25 percent because that is a very high technology effort and you need the elbow room to address the issue of technology.

In the Alternate Turbopump, when you are on the cutting edge of technology, you will have problems that you can't foresee. That would be a number I might pick resulting from the experience that I have had in industry.

Mr. LEWIS. Does the agency in calculation of reserves get an external review by say, OMB, at any point?

Mr. GOLDIN. I haven't in my short tenure here. I have not experienced that, but this is an issue that you and your staff have brought up to us. We take it very seriously, and within an hour of the time I left your office, I had asked our staff to see how we might not only have a base level understanding of reserve within the Agency, but how we might do some independent assessment of that reserve.

Mr. LEWIS. Mr. Chairman, I have a number of other questions for the record, but I think I have used up my share of the time as of now.

GOVERNMENT-WIDE COST OVERRUNS

Mr. STOKES. We are going to come back to you on each item that we go through.

Mr. Mollohan.

Mr. MOLLOHAN. Thank you, Mr. Chairman. First, I would like to commend the chairman for holding these hearings. They are oversight in nature. It is the first time I have been on the Appropriations Committee when we have done that and I think that is a very important role for the Appropriations Committee so I commend you.

I want to extend my personal welcome to you, Mr. Goldin, and the other members of the NASA team who are assembled here today. I think your cooperation in the hearing speaks very highly to your commitments to excellence in our Nation's space program.

The six NASA programs we will be reviewing suggest the propensity that the agency has for cost overruns. I think that is clear at the outset. I would like to note, however, that this problem is a government-wide issue, and not unique to NASA alone.

I am sure that the overrun statistics for the Defense Department are sobering and an analysis of waste and inefficiencies in each of the agencies before the subcommittee would be disturbing, but I say this not to provide NASA with an out, but merely to offer perspective.

The problems and trends that we will uncover today simply must be addressed and I am impressed by your opening remark that you are already doing that. NASA must bear the responsibilities of changing the current modus operandi which leads to repeated cost growth in the agency's programs.

I look forward to this hearing and an analysis of these six programs, and hopefully after they are over, we will be able to better discriminate the factors associated with cost overruns and to factor out what role political indecision plays, what role NASA management or lack of management plays, and I am sure a myriad of other factors. So with that, Mr. Chairman, I will reserve other questions as we get into the specific programs.

Mr. STOKES. Thank you, Mr. Mollohan. Mr. Torres?

INCENTIVE CONTRACTING POLICY

Mr. TORRES. Thank you, Mr. Chairman.

Thank you, Mr. Goldin, for being here today with your NASA team. I want to echo the comments of my colleagues in welcoming your cooperation in giving us a broader view of exactly what reforms or new reviews you are undertaking at our space agency.

I note in your testimony that as a result of the reviews and in response to concerns by the Congress and yourself, regarding contractor performance, NASA policy on incentive contracting is undergoing a vigorous restructuring.

You state that under your new incentive contracting or award fee policy, significant financial penalties are provided under certain nonperformance circumstances. I would like to know for the record exactly under what circumstances would financial penalties be imposed?

Can you address yourself to that? What are these circumstances?

Mr. GOLDIN. Let me address it in a generic sense. There are three circumstances. One, significant overruns; second, significant delay in launch or in delivery of requested services or products that could have severe impact on the Agency; and third, lack of performance of the hardware in its operational state. Some hardware we have delivered for ground equipment and other hardware we have delivered in space, but the key to it all is to say that we in NASA would no longer want to have fee earned for interim progress and cast into the vaults of the corporations. We would like to have the fee earned on a provisional basis so people don't have to lose the cost of capital as they are performing. But if they do not perform they must return every nickel of profit to the U.S. Government and in circumstances of production contracts, return the full fee earning potential they would have had, not just what they earned. So those are very, very severe penalties.

LIQUIDATED DAMAGES

Mr. TORRES. In light of that, Mr. Goldin, a number of years ago I authored legislation in the House that was enacted into law requiring that all Federal agencies, including yours, impose financial penalties or prime contractors if they failed to make a good faith effort to meet their small business subcontracting goals, especially

minority business subcontract goals. That was known as liquidated damages.

Speaking to the issue as nonperformance, if a contractor didn't comply with their small and minority business subcontracting goals could possibly face these liquidated damages or financial penalties? Have these liquidated damages or penalties been imposed as far as you know within your agency?

Mr. GOLDIN. Let me say the following: I believe at NASA we are taking what I consider to be an innovative approach; that we are working with the corporations to really make something happen. Rather than being in a position of penalizing people for not performing, let me tell you what we are doing. We have recently set aside \$1300 million. Is that the right number?

Ms. LEE. That is close.

Mr. GOLDIN. We have a set-aside that only small disadvantaged businesses may bid on. We have formed an advisory council made up of a broad range of entrepreneurs of Americans of color, women, and disabled from all the geographic regions of the United States. They are advising us on how best to do business with small minority-owned businesses, women-owned businesses and disabled-owned businesses. And based upon this, this Committee, I believe, imposed a goal on NASA that we achieve 8 percent of our contracted business for small disadvantaged companies, but there was no date. We took a self-imposed deadline of 1994 and I want to report to you that in 1992 we achieved 7.2 percent. I believe that that is a very positive approach, a proactive approach and I want to tell you there is a commitment at NASA. I also want to say that this Administrator is deeply committed not just because it is the law, but because it is good business and it is important to the country. I have personally talked to the chief executive officers of the companies doing business with NASA to make them aware of the situation that the full diversity of America must be brought into the business of space that we have. And there was not an insensitivity, but a lack of knowledge.

There has been a significant improvement. I want to report to you that there was a job fair out in Los Angeles, and I believe 1,200 people from the minority, disabled and women-owned business community attended that conference.

I personally went to the conference and spent three hours talking to the contractors and talking to the people seeking business to see if we were getting somewhere. They said that in NASA leadership—and I emphasize NASA leadership—across the board, they see a real commitment to change the way we have been doing business. So I believe that we need incentives and those incentives are working. If it turns out we need disincentives we will raise the subject, but right now I believe we are doing the right thing and on the right track.

SMALL AND DISADVANTAGED SET-ASIDE PROGRAM

Mr. TORRES. Thank you, Mr. Goldin. I believe it was our Chairman, Mr. Stokes, who initially introduced the 8 percent figure into the Federal contracts. I am happy to note, as you have just said,

that NASA has reached in attempting to comply with that bill, 7.2. Is that correct?

Mr. GOLDIN. Yes, sir.

Mr. TORRES. I think that is commendable. I do not believe that any other agency, as far as I know, in the Federal government has been able to match that percentage. The chairman will correct me if I am wrong. I think 7.2 is a laudable figure.

And not to belabor the point, I think you have indicated the commitment by NASA to reach these thousands of subcontractors out there, minorities in all kinds of areas, women included. Can you tell me what percentage of these contract awards were service types, technical types of contracts?

I know that often an agency will say, yes, we have met our 4 percent goal and we have outreached and we have provided 4 percent of subcontracts to minorities. Except the contracts always end up being janitors or landscapers or the painters, whatever.

Can you give me a breakdown as to the types of contracts your agency has provided?

Mr. GOLDIN. We will get it for the record, but let me say the following: You have hit on a very fundamental issue. I would like to tell a little story here because I think it is very important and pertinent to the issue you just brought up. It has to do with a visit that I made to south central Los Angeles with Mae Jemison, the first American woman of color to fly in space. We went to the Challenger Boys and Girls Club in south central Los Angeles. I was introduced to these children that were between 8 and 14 years old. There were about 150 of them. There were Asian-American children, Hispanic-American children and African-American children there. I spoke and they politely applauded. When I introduced Mae Jemison who is a physician, 35 years old, out of south central L.A., they couldn't contain themselves for five minutes because they understood the implication of who she was and what she accomplished.

The point you are bringing up is a very poignant one and that point is we at NASA just can't look at a bottom line number that said we are going to meet an 8 percent goal and have people washing our windows and doing our floors. That is not the intention of that. It is to build role models, self-esteem and people in America that want to make real change. So we have set out and that was the whole reason we set up this Advisory Council I talked about. These are all high technology firms. These are people that are on the high technology cutting edge, and the set-aside I talked about, it was for high technology.

We are not just looking at service support. We want to get high technology and we are committed to working with that, and one of the things we are going to be looking at in the future is mentor/protegee programs and we are encouraging our contractors to work with them. I want to tell you that in industry, I started working on this five years ago, and it is a real paradox. Initially the people in my corporation wondered how we could contract to a small minority-owned firm that never built space hardware; we were going to risk our programs. It was unbelievable. We spent hundreds of thousands of dollars with a variety of different firms and firms that had been building ground equipment and had no experience in flight

equipment. But they were a class firm able to deliver lower cost products earlier with equal or better quality, and it broke the paradox. That is what it is going to take, and NASA is deeply committed. I say it not just for myself, but I say it to the full NASA team. It is crucial to the future of our country. So we will get you the figures and we are going to keep improving that ratio each year. [The information follows:]

Please note for the record that this response is tailored to the types of services vs. types of contracts. The following information is provided regarding the types of services NASA acquired from Small Disadvantaged Businesses to achieve 7.2 percent against our 6.7 percent interim goal in FY 1992. These numbers also include awards to women-owned small businesses, Historically Black Colleges and Universities (HBCU's), and Other Minority Institutions (OMI's).

Fiscal year 1992 prime awards to small disadvantaged business, woman-owned small business, historically black colleges and universities, and Other Minority Institutions:

[Dollar amounts in millions]

	Amount	Number
Type of service/product:		
R&D	\$118.0	743
Professional services	56.4	61
Administrative support services	42.6	80
ADP and telecommunication services	31.7	63
Maintenance/repair/alteration of property	28.4	58
General purpose ADP equipment and software	20.7	62
Operation of Government-owned facilities	14.5	20
Housekeeping services	9.5	36
Photographic, mapping, printing and publication services	6.0	21
Construction of structure and facilities	5.2	27
Instruments and laboratory equipment	5.0	46
Management support services	4.3	9
Technical representative services	4.2	5
Metal bars, sheets and shapes	3.7	1
Maintenance/repair/rebuilding of equipment	1.3	20
Education and training services	1.3	5
Ship and marine equipment	1.2	1
Medical services	1.0	1
Communication, detection and coherent radiation equip.	.7	12
Miscellaneous	5.1	79
Subtotal	360.8	1,350
Fiscal year 1992 subcontract awards	491.5	
Fiscal year 1992 small purchase awards	13.0	
Total	865.3	

Please note that this data is broken down by type of effort for the prime awards only. Gross dollars are provided for subcontract awards and for small purchase awards, but data for type of effort cannot be extracted.

Mr. TORRES. Thank you, Mr. Goldin. Some might say I tossed you a softball question and to get an answer like that—I have some tougher questions, but I think my time has run out, Mr. Chairman, and I yield back.

Mr. STOKES. Thank you, Mr. Torres. Mr. DeLay.

LIFE CYCLE COST ESTIMATES

Mr. DELAY. Thank you, Mr. Chairman. I am sorry I was late. Mr. Lewis may have explained we had a Republican conference that

just ended. And I am sorry I missed your opening statement. But in reading your prepared statement, you suggest a management reform under which NASA's Comptroller would do cost estimates in addition to the traditional process of estimation in the programs offices.

Will these be life cycle cost estimates?

Mr. GOLDIN. Yes, sir, there has been a tendency to just focus on development costs and what we are going to ask them to do is to include full range of development costs, all associated hardware, test hardware, ground hardware, production hardware, operations and maintenance costs all the way through the end point of the program. It is very, very critical to do that, so we believe deeply in that, sir.

Mr. DELAY. What is the threshold which triggers such an analysis? Is it that the program spend at least \$200 million?

Mr. GOLDIN. Yes, sir.

Mr. DELAY. How would you respond to the criticism which some might make suggesting that an independent estimation would have to be done by someone totally external to NASA, not your own Comptroller?

Mr. GOLDIN. There was a question that was raised by Chairman Stokes, and he asked whether, in the start-up of a program, NASA would have any objection, before the program was approved by the Congress, if there was an external assessment made I believe by the Congressional Budget Office or the GAO.

Mr. STOKES. GAO.

Mr. GOLDIN. The answer that we gave back was, we believe that if we do the right things our cost estimates will withstand external scrutiny. We at NASA are prepared and willing to accept external scrutiny.

Mr. DELAY. When you say external scrutiny, that is GAO?

Mr. GOLDIN. Well, they were given as examples.

Mr. DELAY. Or anybody.

Mr. GOLDIN. I couldn't answer anybody. You would have to define who it was to put some bounds on it. But if it was a legitimate organization performing the analysis, we ought to be able to withstand the scrutiny of external analysis.

Mr. STOKES. Would the gentleman yield?

Mr. DELAY. Yes, Mr. Chairman.

Mr. STOKES. In the example we proposed to Mr. Goldin, we suggested the GAO as an external unit that would make such an analysis before the subcommittee would approve the funding.

Mr. DELAY. Thank you, Mr. Chairman.

Mr. STOKES. Thank you. At this time we would like to invite your associate administrator, Mr. Jeremiah Pearson, to join you at the table, Mr. Goldin.

Mr. GOLDIN. While Mr. Pearson is coming up, I would like to make one point of clarification. On the procurement reforms we have sketched an outline of what we are planning to do. We clearly have to have approval by OMB and OFPP before it goes into the Federal Register. So I just want to say for purposes of clarification, as soon as we get the proposal back we will be able to publish in the Federal Register, and if there are some changes we will deal with the changes at that point in time.

I am just giving you a status point at this point in time.

PRESIDENT'S COMPETITIVENESS AGENDA

Mr. MOLLOHAN. Mr. Chairman, I just have one question.

Mr. STOKES. Sure, Mr. Mollohan.

Mr. MOLLOHAN. It occurs to me you were up here talking about some management problems and cost overrun problems that you have in your agency. At the same time NASA is—I would submit NASA is being asked or at least invited to participate in the President's competitiveness agenda specifically by making technology contributions to the commercial sector. And so at the same time you are up here dealing with management problems and cost overruns, there is this mandate, or at least I say impatience out there to incorporate technology into your initiatives, new technology. And as I understand it, listening to some NASA folks, there is a considerable risk associated with that—which cost money—and so I guess my question would be, does NASA, see a role for itself in the competitiveness agenda of the President? Does it see that role as pushing technologies in its programs and having a competitiveness responsibility in transferring that technology to the private sector? And what do you think about accommodating the costs of the risks associated with such missions given this overall concern about procurement?

Mr. GOLDIN. Let me say this: If NASA is not on the cutting edge of technology, given the new world that we are working in, it is very hard to argue for NASA's relevance. It is crucial as we perform our very difficult missions. The Mission to Planet Earth is going to require technology advances that we haven't even dreamed of. Human exploration of space in space stations where we are going to be just breaking technology barriers to explore the planets in a cost-effective manner, and do it in years instead of decades, and do it with spacecraft that weigh hundreds of pounds instead of thousands of pounds, is going to require advances in technologies.

NASA must be on the technological edge or we are not the Agency that we ought to be. So I will start off by saying that given that we do the right kind of requirements analysis, given that we submit ourselves to independent cost assessment and get started, we will perform. I do want to say that NASA has a very proud record of technology transfer into the private sector, and that may be one of the best kept secrets in the world. But we have an incredible number of industrial associates and affiliates throughout the country where we are making major impact to the medical industry. We are impacting the heavy industry manufacturing, and we are generating new products and new ideas.

So I think that NASA is very relevant and the only way we could be there is being on the cutting edge. It is crucial that we be credible in our management because NASA should not only be a shining light in technology; NASA should be a shining light in advanced management approaches that other government agencies and other U.S. corporations could take on.

In our past when we got started during the Apollo era we were a leader in new management techniques. Some of these reforms we are talking about today I think can get us back to that place.

TECHNOLOGY AND RISKS

Mr. MOLLOHAN. But is this concern over risks and pushing technology and risk associated with that? And how do you accommodate that? If you were going to push technology, you are going to do the space station with cutting edge technology, at least I hear that. Is that a concern?

Mr. GOLDIN. Let me give you an example. You have to take risk when you get to the cutting edge. Our society has become a society that doesn't want any risks. If we have a hundred out of a hundred successes in NASA, I think we will have failed as an Agency in making change and providing a good future for our children. If we have a hundred out of a hundred failures we have sloppy management. I think the answer lies somewhere in between. America has always been a bold country. We have always taken risks and when we take risks we have great achievement.

Who would have thought about the Apollo program, that we could have gone to the moon in eight years if we sat down and said what is the risk. I think we can be bold and I think we can deliver.

I give you a case in point. I challenged the wonderful women and men of the Jet Propulsion Laboratory to break with tradition and cut a spacecraft weight in half, cut the cost of the mission in half and deliver equal or greater science. They have taken up that challenge and they have a prudent program where they are working on advanced technology over the next two years to prove in advance before we commit the big money that we could do it. They may succeed and they may fail. We will not have expended the full amount of money that NASA has, but we will have gone to the cutting edge and that is the place where we have to be in many of our programs.

Now, when we have a very large program that is very complex like the Station, I believe we have to measure the risks we take in the engineering infrastructure; but we should certainly go to the cutting edge in the experiments and the payloads that go into that Station and we shouldn't have second rate payloads and second rate science. We should go right to the edge in science and technology, but have a prudent set of risks because we have human beings involved and we don't want to risk human life up there when we are going to put up an infrastructure for 10 years. That is how it balances out.

Mr. STOKES. Thank you. Off the record.
[Recess.]

WASTE CONTROL SYSTEM

Mr. STOKES. The committee will come to order.

The first program we will discuss is the shuttle toilet.

General Pearson, I have had an opportunity to read your statement before the House Science Committee, and I fully understand that building a toilet for space is a good deal more complicated

than the one that we are accustomed to having in our homes. I think that is not the real point.

The point is, if I understand it right, the contractor, Hamilton Standard, bid a price of \$8.2 million to produce two production waste collection systems. What was delivered was only one production unit at a cost of \$23.4 million. In fact, you stated in the PDR, the complexity of the project had to be scaled back or the bill would have far exceeded the \$23.4 billion price, is that correct?

General PEARSON. Yes.

Mr. STOKES. Now, did the contractor bid to a NASA RFP that contained a set of requirements and specs?

General PEARSON. No, it didn't. That is part of the problem.

Mr. STOKES. That is part of the problem, right?

General PEARSON. Yes.

Mr. STOKES. Was the original RFP flawed?

General PEARSON. Absolutely.

Mr. STOKES. Tell us how.

General PEARSON. Okay. I think this is a perfect example of not setting a requirement and changing requirements as you go through it. In the beginning, we held a place in the Endeavour procurement, of which this was part, to build a waste collection system. Now, the costs for this system was a placeholder, because we didn't know what we wanted. We were at a point when we were on a 16-day limit on the orbiter and we wanted to go for longer duration. Originally, the shuttle was designed for seven days, and a waste collection system was designed for that period. As we moved along in this process, the Endeavour was designed to go for a longer period. We ran out of capacity in the waste collection system. But, also, I would like to put this in context. Remember, this was a less than 2 percent of a total program that came in under cost, and on time, the Endeavour. This was actually a change order in the program. So the requirements were really not well-defined. The program managers just said, "come up with a waste collection system that will last 16 days."

There was only one contractor that even bid on it. The design just was not defined until the preliminary design review, and the contractor thought they were giving us a one-flush system, which would have been extremely expensive.

We came up with a simplified system for the requirements, and still it cost more than we ever thought it would cost. We made mistakes and we didn't watch it very closely. But the Administrator has put the charge to me that NASA programs will come in on time, on cost. The way we will prevent this in the future is that we will have designs that make sense. We need, up front, to understand what we are doing rather than just say go build a toilet.

Mr. LEWIS. Will the Chairman yield?

Mr. STOKES. Certainly, Mr. Lewis.

NEW WASTE COLLECTION SYSTEM

Mr. LEWIS. Please help me understand. As I understand it, the Endeavour was a replacement for Challenger; wasn't it?

General PEARSON. Correct.

Mr. LEWIS. Can you really justify that, suggesting that this was the first go-round in terms of design?

General PEARSON. For the new waste collection system it was a new design; it was a seven-day orbiter before, and we were going up to 16 days and we ran out of capacity, and all sorts of things like that. You would get a synergistic effect by using this same waste collection system in the Space Station. So we were trying to think ahead.

Mr. LEWIS. Thank you.

And the Endeavour then was designed for extended flight?

General PEARSON. Extended duration, exactly.

Mr. STOKES. It is true that Endeavour itself, I guess, came in under original cost, it is just that the toilet part went way out of control?

General PEARSON. Way out of line, yes, sir. And we made mistakes, but we have been charged to fix them and we will.

Mr. STOKES. I noticed that you indicate, quote, "that additional analysis led to unplanned expenditures", what does that mean?

General PEARSON. That meant that, as I said before, we went from the automatic one-flush system to understanding what we really wanted. The problem is that we didn't set the requirement and tell the contractor exactly what we wanted. They gave us more than what we thought we needed. We decided, the astronauts did, that we really didn't need all that fancy a system; but it still was so complicated that we significantly underestimated.

COST OF ADDITIONAL WASTE COLLECTION SYSTEM

Mr. STOKES. If NASA will elect to buy a second production unit, the cost would be \$6.7 million, is that correct?

General PEARSON. I assure you, Mr. Chairman, if and when we buy another one, we will take the specifications, the drawings and bid it out to get the best possible cost; and I don't think it is going to be \$6.7 million; I think it would be considerably less.

Mr. STOKES. We are hoping you mean less by that.

General PEARSON. That is right, thank you.

Mr. STOKES. Mr. Lewis, I yield to you.

WASTE COLLECTION SYSTEM PROBLEMS

Mr. LEWIS. Thank you, Mr. Chairman.

I was interested in your written testimony in which you described the early days of Apollo and the all-male crews. They used a relief tube system similar to that used on military aircraft to dispose of waste into space. This venting system used up quite a bit of the precious crew cabin air. Solid wastes were collected in fecal bags that were attached to the suit. This did not prove to be hygienic, as the material was not always successfully contained and did little for crew morale.

To say the least, we are talking about challenges and problems that involve a totally different environment. I would hope that those who do believe that NASA is making a good faith effort to move forward to meet this challenge in a positive way, would recognize we are operating in an entirely different environment than is normally discussed or understood by those who write articles.

Is it accurate that the cost of the shuttle toilet was \$23.4 million and not \$30 million, as suggested by GAO?

General PEARSON. That is correct; the \$30 million estimate would have included, as the Chairman says, the second flight unit.

Mr. LEWIS. I assume it is correct that the primary problem with the shuttle toilet is change orders which were initiated after the contract had been awarded?

General PEARSON. Absolutely. There were no defined requirements. You have to tell somebody what you want to have them make the way you want it. And we haven't done that.

Mr. LEWIS. Thank you, Mr. Chairman.

Mr. STOKES. Okay.

Mr. Mollohan.

Mr. MOLLOHAN. I don't have any questions.

Mr. STOKES. Mr. Torres.

SPACE STATION REDESIGN

Mr. TORRES. Thank you, Mr. Chairman.

Mr. Chairman, earlier in your opening statement and throughout this hearing, the subcommittee has commented on the GAO report which cited redesigns as one of the reasons for cost overruns. NASA has been directed by the President to redesign the Space Station. Isn't there a risk that this new redesign will ultimately cause additional delays and cost growth? If a redesign can be achieved at all?

Mr. GOLDIN. NASA has been issued—

Mr. STOKES. Let me just, if I can—are you getting into the Station?

Mr. TORRES. Yes.

Mr. STOKES. If you would just withhold on that and when we get to Station, I will recognize you for that.

Mr. TORRES. All right.

I yield back my time to the Chairman.

Thank you.

Mr. STOKES. I appreciate that.

Mr. THORNTON. Mr. Chairman, I have no questions at this time.

WASTE CONTROL SYSTEM DESIGN

Mr. STOKES. All right.

Thank you, Mr. Thornton.

General Pearson, let me come back for a moment to sort of crystallize, or capsule, or put into final conclusion form what I understand you have testified to in terms of this toilet. Let me ask you if this a fair way to express it; that you are telling us that it cost an extra \$14 million to get the contractor to build a toilet that was less capable than the one that he had agreed to deliver for only \$8.2 million; is that a fair statement?

General PEARSON. No, sir. I would say that we didn't design what we wanted. The contractor assumed we wanted something more capable than we did. But even at that point, we hadn't defined the cost or written a contract. So we came in and refined it; what was delivered was less capable than they had originally proposed, which would have been even more money.

Mr. STOKES. All right. But at the point where he was saying he could produce what you wanted, he was also saying to you that he could do that for \$8.2 million, was he not?

General PEARSON. I think that was——

Mr. ALDRICH. That is right.

Mr. UTSMAN. Yes, that is correct.

Mr. STOKES. I guess what I am trying to get at, we wound up with something at \$21 million, that was not as good as what he said he could produce at \$8.2 million. Could you explain that to me?

Mr. UTSMAN. I would have a very difficult time explaining that it was a rational process. What we didn't do was have a clear understanding of what we wanted and what they wanted. I think that the whole team started down the road with an ill-defined concept, without doing the in-depth planning to really understand what they were going to deliver.

The contractor did sign up for \$8.2 million, but I don't think he really understood until we really got down the road the full ramifications. I think it was clearly a lack of in-depth planning and understanding on everybody's part.

Mr. GOLDIN. I would like to make a comment on this, if I may?

Mr. STOKES. Certainly.

I yield to you, Mr. Goldin.

Mr. GOLDIN. There is a general issue here with regard to accountability and responsibility. I believe we at NASA did not lay down the requirements. But I also believe, on the contractor's side, if a contractor doesn't have a clear set of requirements, they have an obligation to talk to NASA. It gets back to the process that I was talking about in the beginning, if we have a clear process set up to allow for communications on a competitive basis between NASA and the contractors to work through and sort through the requirements, we will end up with a better product. It is when we write things on slips of paper and we are in such a rush to get a job done, that we don't define the requirements and it comes back to where we started. This, I believe, is the fundamental issue that we have to deal with. So as much as I believe on the NASA side there is a problem, I believe that the contractors have an obligation when they see an issue coming up to deal with it squarely, and head-on, and come back to NASA and tell us we haven't clearly defined things. And that is again part of the reform process that we are talking about. We want to incentivize the contractors again, not just to win, but reform and perform. And I think the reforms we talked about are crucial here.

Mr. STOKES. You mentioned the contractors. Let me ask you this, had this particular contractor ever built a toilet before?

General PEARSON. No, sir, the contractor for the earlier Shuttle of system was General Electric, and they didn't want to bid on it.

Mr. STOKES. I see. One additional question. In light of your testimony with reference to not thinking that the next time would cost \$6.7 million, would it be fair if we cap this particular cost not to exceed \$6.7 million?

General PEARSON. Absolutely. Absolutely. And I would hope to get it at a lot less than that.

ADVANCED TURBOPUMP

Mr. STOKES. Thank you. Any further questions? Then we will turn to the second program, Advanced Turbopump. This program has incurred an overrun of more than 250 percent and actually is one where the committee has attempted to provide some oversight. The overrun in this program caught our attention more than two years ago, and as you know, we originally recommended canceling the ATP. However, we recognized that if these pumps, that is the hydrogen and oxygen pumps can be successfully developed, they will provide extra safety margin on the shuttle main engines.

Because of that fact, the committee agreed with the NASA proposal to delay the hydrogen pump for two years and concentrate on the oxygen pump. The committee also set a milestone, with NASA's concurrence, of achieving 6,000 seconds of testing by December of 1992.

Although NASA did achieve the 6,000 seconds, because of numerous vibrations and other problems encountered during testing, it was not clear whether the milestone was meaningful.

The committee then suggested a new milestone of March 31st, to see if NASA and the contractor, Pratt and Whitney, could solve the technical problems.

Now, just a couple of weeks ago when Mr. Lewis and I visited Marshall, we were told that some progress was being made, but that you would know better by late March or early April.

That is a brief synopsis of the committee's role in the ATP overrun. What we were trying to do was to get NASA to agree that as critical as these new shuttle main engine pumps are, at some point we simply have to throw in the towel and stop spending money.

The question I guess I would like to pose to you at this time, in light of the involvement of the committee and concern of the committee over this period of time, has the committee performed a responsible role in bringing this large overrun under control or do you believe that by taking this type of action we are micromanaging?

General PEARSON. I think this is a fine effort here in the committee oversight. Working with the Committee has allowed me to go to the contractor and say it was time to fish or cut bait. And they took it upon themselves, which they should have been doing a long time ago, to develop a parallel path of production so we would have alternate solutions. And I think they are rapidly demonstrating that we may be coming to a closure on this. And with the added emphasis that I could get from this Committee, I was able to go down there and draw the line. They have made excellent progress in the last few months, and I would hope that we are going to give you an answer within the next week or so on the final definition of the pump so we can start on with the certification test.

Mr. STOKES. Mr. Utsman, would you care to comment on this at all?

Mr. UTSMAN. No, I don't feel there was any micromanagement. It was well timed, as we felt in the program, to draw the line, and we couldn't continue looking at this as if this is a technology WPA program. We either had to do it or admit that this was something

that was beyond our capability at this point in time. I think the team has responded well. I think when they realized that this was coming to closure, they performed really superbly, and we think we are going to bring you a story that is going to have a happy ending.

Mr. STOKES. Let me ask you this—I am sorry.

Mr. Goldin, I am sorry.

Mr. GOLDIN. I wanted to say something.

Again, I don't believe that this is a case of micromanagement. However, I think we in NASA ought to ask ourselves how did we allow the situation to get to this point. And I think the committee had every right to taking the action it did. But I would hope in the future that we will have more rigorous controls so we don't have to get the oversight of the Committee, and I emphasize oversight not micromanagement. It was not micromanagement.

COST GROWTH OF THE ATP PROGRAM

Mr. STOKES. Thank you.

The ATP program, as the chart suggests, has grown from \$198.7 million to well over a billion dollars. Some of that growth occurs because the original contract did not include any provision for production flight pumps, is that correct?

General PEARSON. Correct.

Mr. STOKES. Can you tell us why?

Mr. UTSMAN. There was an assumption made that the funding in the operational program would be adequate to be able to fund it. There was no independent probing that an independent cost review would have done, and consequently, it turned out to be wishful thinking rather than a correct assumption. As the Administrator said, the Program Commitment Agreement review and the independent cost reviews, and all those kinds of things that are aimed at nailing down those things before we get started, would have been beneficial in this case.

Mr. STOKES. Is it correct that the development, which is only part of the program, has grown from \$198.7 million to \$654.6 million, including the two-year slip in the hydrogen pump, is that correct?

General PEARSON. That is correct.

Mr. STOKES. Now, let me ask a question that I know is relatively tough to answer, but I would appreciate as straightforward a response as possible. And, of course, both Arnie Aldrich and Tom Utsman are here and both of you were involved in the contract.

If you knew in 1987 that what had been advertised as, roughly, a \$200 million program, was going to grow at a minimum a \$1.1 billion program, would you have gone ahead?

Mr. UTSMAN. Let me speak for myself.

I think in the context of 1987, the answer would have been yes; and the reason is fairly clear. If you look at the safety hazards associated with the shuttle program, they inherently fall into two camps. One is in the solid rocket booster, and the others are in the engines.

We have the ASRM program addressing the solid rocket booster problems. When you looked at the engines, the most critical parts of the engines have always been determined to be the turbopumps. So if you were going to increase the safety, and this was coming

out of the Challenger accident period, then you had to fix the turbopumps and fix the engines. I think at the time the investment, considering you are talking about a program that is going to go decades and running \$4 billion a year, a \$1 billion investment in order to substantially improve the safety of a program that would expend for the Nation \$80 to \$100 billion, would have seemed to me at that time a prudent investment. I think we got caught up in the euphoria that we were going forward to fix it, and didn't do the proper program management that we should have done at that point in time to define and communicate effectively the cost. But I really believe strongly that we still need the pumps, the Nation needs it if it is going to make the shuttle a stronger, safer vehicle.

Mr. STOKES. Did you want to comment?

General PEARSON. I would just say that we grossly underestimated the requirements. And we are not going to do that any more. As the Administrator says, we put the Program Commitment Agreements in effect, and that independent cost analysis, and those will work. But then again, remember, we grossly underestimated the requirements. You are talking about putting, roughly, the equivalent of a Corvette into a one-pound box. It has been a tough technological problem. But we still should have had an independent cost analysis and had a better handle on the requirements.

CONTRACTOR REQUIREMENTS

Mr. STOKES. How about the contractor situation here? Was this another case of a contractor being totally unrealistic, or one who was in over his head?

General PEARSON. I don't think they realized the technical complexity. You could correct me if I am wrong, but I just don't think the contractor had a real good handle on it, and came in with a cost to get the contract, to get in the business.

Mr. UTSMAN. You know, I think that is right. We had taken some technology, in hindsight, that was strictly in the laboratory and tried to put it in full production. These were the fine-grained microcastings, or the castings that we have manufactured that allow us to eliminate all the welds. Essentially, this is going to be used as the cutting edge in all high-performance engines, both for shuttle or whatever follows the shuttle. And to manufacture those castings, essentially we should have foreseen that it was going to take a lot more effort to undertake the casting methodology. It added some 18 months to the program.

The 18 months in a development program is a lot of dollars, and it extends on out, and we should have known and foreseen that that was going to be a very difficult part of the task. The rest of the problems that we ran into, I think, are nominal problems. We probably were looking at the experience we had in the development of the other engines, and we underestimated even there. I think we went every way on looking at the rosy road, without looking at it realistically.

CAPPING THE ALTERNATE TURBOPUMP PROGRAM

Mr. STOKES. Let me ask you this. Assume that you continue the liquid oxygen pump tests, through the month of April, with no

problems, then you come to us with a proposal to proceed with the program.

Given the growth history that we have already discussed, I would assume you would have no objection to us capping this program?

Mr. UTSMAN. We would not have any objection to capping. We would ask for forbearance to make sure, as we come forward to you, that we have good, solid estimates. We have talked to the contractors about looking at the degree of firmness in their estimates and about firmer estimates for the development program, to assure that we both have a clear understanding of the risk involved. We have an interest in something like a fixed-price incentive, which says you really understand where you are. Not only that, but we are interested in capping the production buy. So we should be able to limit the liabilities, have a clear understanding with our contractors on what we feel the development involves, and the risks are associated with it.

Mr. STOKES. And that would certainly be fair.

Mr. Lewis.

NASA'S VIEWS OF THE CONTRACTORS

Mr. LEWIS. Thank you, Mr. Chairman.

That last response immediately takes me to NASA's view of the contractors who might be involved, their willingness to do business in the fashion that you suggest. You had discussions that would indicate their willingness to do it in this way?

Mr. UTSMAN. The discussions have gone like this: They have been preliminary in nature and they have been based on the fact that the contractors for the other improvements in the program feel that they have reached a very mature position. When you look at them, where they are with regard to test history and that, that is a true statement.

I know no other way to drive out risk than to make the person who is going to have to put his money at risk, sit down to do it, and say, I am willing to do it for this price and for this bid. Then we start to communicate, and we both understand the risks.

I have talked to them. They both have expressed a willingness to discuss it, and they are looking at it.

This has also had a very bad name. It doesn't cure problems if you don't understand what you are buying and what you are selling. And so what we are really trying to do is make sure we get that communication up front, know where we are going, so that we can pin a price on it and come to you with the confidence that we can deliver.

Mr. LEWIS. Have those discussions included the penalty kind of incentives that Mr. Goldin described?

Mr. UTSMAN. Inherent in a fixed price system is a penalty situation.

Mr. LEWIS. Or they lose their fees at the other end?

Mr. UTSMAN. They lose their fees and can actually lose profits from other products where they would have to pay.

Mr. LEWIS. Okay. In this program, you have made at least two major decisions to redirect the efforts since 1990. One was to defer development of the fuel pump as you resolve development of prob-

lems on the LOX mechanism. Another was to direct Pratt and Whitney to be a subcontractor to Rocketdyne. These decisions suggest some level of either uncertainty or dissatisfaction with the contractor.

Mr. UTSMAN. I think that in all honesty, we were not happy, as you might guess, with the progress we were making. We wanted to get a focused attention, so we looked and made the decision that we would focus our attentions on the LOX pump. And as we made progress, it was our intent to come back and look at the hydrogen pump on the basis of the progress. The inclusion of Rocketdyne into an oversight role was fundamentally to get to accountability.

These pumps are part of the engine. What we did not want to do is have a contract with the government where when it came time, we gave Rocketdyne part, and Rocketdyne said, "I can't certify my engine." We wanted to have Rocketdyne saying we have got an engine we believe in earnestly, even though it has a Pratt pump in it.

ALTERNATE TURBOPUMP PROGRAM INCREASES

Mr. LEWIS. To what extent, if any, were increases in the Alternate Turbopump Program caused by either of the two prime contractors?

Mr. UTSMAN. I am not sure. The performance has been fundamentally Pratt and Whitney's for performance. Rocketdyne has aided with technical assistance and suggestions. They have been mainly providing integration, how it is going to fit in. If you are talking to what is called the "wrap," the additional cost by subcontracting, in general, the direct costs for people working on the project, that is well thought out. They are providing technical input in that.

In the remainder of the cost, there is an additional amount of fee that is carried to get the responsibility and accountability to one person. And it is a matter of it being spread over a larger base rather than a smaller base, so it does cost you a little bit more to do business this way, but you have got to trade that off on the accountability and what you are really looking for at the end. If we did not have Rocketdyne doing that, we would have to have more civil servants working that same thing. You don't get the insight without paying for it somewhere.

TESTING OF LOX PUMP

Mr. LEWIS. What did you learn from the tests the Chairman and I saw in February of the LOX pump?

Mr. UTSMAN. The bearings have been the problem. We have had overheating in the bearings. Our loading methods have been changed in the tests you saw. That is leading us down to successful solutions to that bearing-loading problem, without getting terribly technical beyond both of our capabilities.

Mr. LEWIS. I have had some difficulty understanding from the very beginning, but that is what this is about. The Chairman is trying to help me out.

Mr. UTSMAN. It is a very difficult problem.

General PEARSON. This bearing problem is really kind of interesting. Rocketdyne had gone all out since we got the help from your Committee. Actually, Pratt has gotten the Russians down, who have similar types of pumps on their rocket engines, and the Russians have been going all out to help us in this problem. And we feel pretty certain that we are there, thanks to this parallel development that we instituted that we should have been doing all along. So as Tom said, there may be light at the end of the tunnel here.

Mr. LEWIS. Thank you, Mr. Chairman.

Mr. STOKES. Mr. Mollohan.

SPECIFIC ATP PROBLEMS

Mr. MOLLOHAN. Thank you, Mr. Chairman.

Well, this is the second program that we have talked about, and in a thematic sort of way, there are the same answers from this program as were offered up in regard to the last program.

The responses here have been like this: We grossly underestimated the requirements; we didn't do proper program management; we didn't appreciate the technical complexities; we should have foreseen; we underestimated.

If that is all we get out of this, I am not sure I will in any way understand in specific sorts of terms what the problems are, nor appreciate the kind of proposals that the administrator has suggested this fixes for the problems.

So I would like for you, if you would, to talk in a bit more detail about when you say, "and I guess we sort of grossly underestimated the requirements." In regard to this program, could you talk in a bit more detail, maybe chronologically, to what criteria you would consider that leads you to say now that we grossly underestimated the requirements?

Just as a start, how did you grossly underestimate the requirements? What went wrong? What should have you done differently?

Mr. UTSMAN. I think any time you are dealing in a technological development such as this, we should have started with the materials we were using, which were essentially the castings. As I explained earlier, we had only had laboratory developments on the casting. We had not really done it in full parts.

Mr. GOLDIN. Excuse me, Mr. Mollohan, I would just like to help him clarify.

Could I just take a minute; is that okay?

Mr. MOLLOHAN. Yes, sir.

Mr. STOKES. Sure. Please do.

Mr. UTSMAN. It has been suggested I give you somewhat of a context of the problems.

Mr. MOLLOHAN. Is that just a suggestion?

Mr. UTSMAN. My colleague, the Administrator. The original pump, due to the need to put it into the orbiter and keep it small, had to be done from the technologies of that vintage with welds; and we had a lot of welds—somewhere over 700 to 800 welds. Those welds are uninspectable, many of them; so, if you have a concern about welds being made, you can't inspect them and have them let go at some inappropriate time. So they are a high risk element.

So what we were looking for in improvement in safety was to be able to go to the castings which have no welds, and are completely inspectable. There were developments made during the late 1970s and early 1980s in these fine-grained precision castings; these were more or less laboratory developments.

The casting is very difficult to make, because in a conventional casting, you use a lot of time and you get coarser grained materials. We are trying to have high strength materials with a nice, fine grain, which cuts down porosity. It leaves you smooth-faced finishes, so when you have your flows through them, you have efficient flows and don't get inefficiencies. So this drive to this casting technology essentially led us into difficulties in scaling it up and bringing it from the lab. And it took us about 18 months over and beyond what we had planned. We should have anticipated that it wouldn't just be straightforward.

INDEPENDENT REVIEWS

Mr. MOLLOHAN. Okay. Now, how should you have anticipated that, through what process? This gets to answers about how we underestimated the complexity of the problem, and I think the premise here is by saying that that led to cost overrun. So what I am trying to understand is how you underestimated. What process did you not go through that the administrator is now suggesting are were going to go through to avoid the problem?

Mr. UTSMAN. In the process of coming up with the contract, essentially, it is like anything else. You would be planning it in-depth. It would get an independent review, which would check back what is the experience from past programs and being able to take technology.

Mr. MOLLOHAN. Is that independent review a contracting process? When you say independent, you mean independent within the agency?

Mr. UTSMAN. Independent within the Agency. The process that was used here involved a change within the program. It involved agreement as part of the budget process and, essentially, didn't get that type of independent review.

Mr. MOLLOHAN. So really in this case NASA is taking responsibility for not giving adequate requirements to the contractor; is that what I am hearing?

Mr. UTSMAN. I am saying that in this case, the contractor and NASA both should have understood that the casting problem would probably take a lot longer than going straightforward. We should have recognized there would be problems in it based upon the history of bringing new technologies from the laboratory state into full production.

Mr. MOLLOHAN. Now, how does that translate into our themes of cost overrun causes? Based upon the review that you did, with its admitted inadequacies, it led to a cost estimate. Did you associate a cost figure with this initial review?

Mr. UTSMAN. For the castings?

Mr. MOLLOHAN. For the whole program.

Mr. UTSMAN. For the whole program. Yes.

Mr. MOLLOHAN. You said you grossly underestimated the requirements.

Mr. UTSMAN. Yes. We had estimated \$100 million to be what the program would cost.

Mr. MOLLOHAN. And that was based on grossly underestimated requirements?

Mr. UTSMAN. That is correct. As we went through and found the problems, we wound up the estimates, and as we upped the estimates it became clear that we had an overrun situation.

Mr. MOLLOHAN. And was that upping the estimates in regard to this specific program? Was that an incremental sort of thing as we discovered it?

Mr. UTSMAN. Yes, sir.

Mr. MOLLOHAN. As it fell in on us we discovered that on this phase our estimates were wrong and so we upped it, and then this pattern just became repeated at each phase? What would have been the fix for that?

Mr. UTSMAN. I think going back to the Program Management Council, as is recommended with a go/no-go decision. Internally, NASA will be looking at costs that exceed a percentage, that is. Such a review would indicate that our plan is not correct, and that we should be coming forward with recommendations either to stop the program or not.

Mr. MOLLOHAN. So, as I think I heard the Administrator say, you would call a time out at that point.

Mr. UTSMAN. That is correct.

Mr. STOKES. What would you do at that point?

General PEARSON. What is going to happen is I am going to sign up with the Administrator for a program; I want to make sure it is correct because I don't want to come back and say, hey, look, boss, this is messed up. We have got to do something. If program cost growth goes over 10 percent, I am going to have to go to the Program Management Council. We are going to have to reevaluate it by the highest management council. They are going to say whether it should proceed, or cancel, or we renegotiate the contract. There will be something like this so this won't be able to happen.

Additionally, in the beginning we will have had an independent cost analysis which will double-check our work that we are in a reasonable ball park; I am sure the Committee will want to see that, too, when that happens.

MANAGEMENT REQUIREMENTS

Mr. MOLLOHAN. I am interested in asking what kind of a management style this is. Is this pervasive in NASA, this style? Going to the general now from the specific, is this style now or in the past pervasive? Or is it on a program-by-program basis depending on capabilities or management style of the ladder of management, that these critical reviews occur or don't occur? Or is what you are describing, with regard to this program, SOP in NASA and generally applicable to all of its programs?

General PEARSON. I wouldn't say it is SOP, sir. What I would say is this is a program in which mistakes were made. The Administrator and all his gang have taken a lot of effort to figure out a way to

not make this happen again. There are good examples, as I described before, the Endeavour, which came in on time, and \$200 million under cost.

Mr. MOLLOHAN. That is because of or in spite of?

General PEARSON. That is because we set requirements. We knew what we wanted to build. We didn't underestimate the requirements. We knew what we wanted. We told the contractor; we got a fixed price; and they delivered.

Mr. MOLLOHAN. So Endeavor was a different approach; is that what you are telling us?

General PEARSON. It was not a different approach. It was executed in a better manner, I would say.

Mr. MOLLOHAN. Well, that is my question and maybe I am not articulating it very well. My question is what kind of management requirements or lack thereof would allow this kind of mismanagement as you described associated with this pump program to go forward and does that characterize NASA style with regard to all programs or is it unique to this or these six programs?

In other words, is it an individual manager's problem? Is it a general management structure problem at NASA?

General PEARSON. Well, obviously the management structure has had faults in it. The Administrator has charged us to find better ways to do business, which we have been describing to you. There have been mistakes made, but there have been some triumphs, too.

Mr. ALLISON. Could I say something about this?

Mr. MOLLOHAN. Please.

Mr. ALLISON. This is a bit different. Both these programs were a bit different. The ASRM is a bit different than would normally happen in a NASA program or project. These took place within an ongoing program. It was in Shuttle operations and production. They took place at a particular point in time where we were under great pressure to improve the system that we were on.

So there were two forces there. You had a modification that didn't necessarily get the type of review a new initiative would get, like a new spacecraft development or something like that. So these were inherently different in their nature and, unfortunately, did not get the same kind of review.

Mr. MOLLOHAN. That is helpful because you really do have a problem if in all these programs that NASA grossly underestimates requirements.

Mr. STOKES. Will you yield to me for just a moment?

Mr. MOLLOHAN. Yes, sir.

Mr. STOKES. On the Comptroller's comment, the very next program we are going to discuss is the Mars Observer Program and that was a whole new program—

Mr. ALLISON. It was.

Mr. STOKES [continuing]. Where you had the same problem.

Mr. ALLISON. It got reviewed. It really was reviewed. You will hear the problems with that because they are a different set of problems.

MANAGEMENT PROCESS

Mr. LEWIS. Mr. Chairman, to follow up earlier we talked about Endeavour and we built shuttles before but the one system that was new happened to be the system that got screwed up. It is when we start down a new path that we seem to have difficulties with the management.

We are going to have a management process in this committee that is a little different than I have seen before. I think all our agencies ought to know that when questions along these lines begin to be asked it is not going to be one more simple year. It is a very serious concern of this committee when new programs are initiated, that we get a handle and know that there is going to be a penalty at the other end if it doesn't work.

Mr. STOKES. I yield back.

PROGRAM CAP PROCESS

Mr. MOLLOHAN. I just had one more question. Thank you, Mr. Chairman.

The Chairman asked you for capping and inviting you to say, "yes, please cap our programs." That actually overstates it, Mr. Administrator, for the record. But anyway he did invite you to agree to have your programs capped. I would just be concerned that you almost agreed too quickly with that, because—and I think the response should be not arbitrarily we want to go through this process and give you a number and I know you didn't mean it arbitrarily. What I am inviting you to do is tell me what process you go through to give you a number so we can cap your programs.

General PEARSON. On the toilet or the turbopump?

Mr. MOLLOHAN. Any program. I think these principles ought to be applied across the board.

Mr. GOLDIN. Could I answer that because I think it is more directed towards the overall NASA program.

Mr. MOLLOHAN. Yes, sir.

Mr. GOLDIN. Let me say the following: I think it is appropriate to cap some programs and to not cap others. If we have a program that is in production, it is very, very appropriate to use the right kind of contract, and I come back—

Mr. MOLLOHAN. I don't understand what you just said. If we have a program it is proper to use the right kind of contract?

Mr. GOLDIN. There are different types of programs. Let me break them up into a few different piles. There is the front-end development program which is generally high risk technology. Then there are production programs which are reducing that technology to practice and building multiple units. Let me just use those two examples and break development programs into two types.

There are development programs where we are not extending technology but just applying technology and there are development programs like this Alternate Turbopump where we are on the cutting-edge of technology. Let me make those three piles, okay.

In the production-type contracts, I am not sure that a cap is the approach you want; but what you might want to look at is two types of contracting. There is the fixed-price contracting which in effect says, you bid, this is the dollar value, you overrun that dollar

value, and automatically by definition you have a cap. So that is one approach.

A second approach is to say, okay, this production contract may be a little bit nonconventional so what I would like to do is go to cost-contracting; but let me tell you, contractor, there is going to be a negative incentive and if you do not perform on this contract, you will lose not just the fee you have earned but the potential fee. So, perhaps you earn a 7 percent fee, but the maximum fee is 15 percent. You give back 7, plus 8 percent, so you get penalized. That is another approach to the problem.

A third approach is another cost-type contract. In addition to having this provision on fee, I am also going to put an absolute funding. So it is cost-type until I reach a ceiling, and when I reach that I cannot go above it and, in effect, I have gone to a fixed-type contract. That is why I wanted to discriminate among the different types of contracts. I think there are those types.

When we get into development contract I think it is more appropriate not to put a cap on the contract to the contractor. If you reach the cap, you keep on spending money, but NASA has to have some criteria whereby we would agree with the OMB and the Congress which says if this program exceeds a certain dollar value, we are not being responsive to the American public, and at some point in time you just cut the contract off.

Mr. MOLLOHAN. Well, that is a policy question. In the first instance we don't want to spend any more than that amount of money on this program, and then the experts come back and say, 'well, you can't do that program unless you do spend more.' That is an policy question, it seems to me, in the first instance.

Mr. GOLDIN. And I wanted to discriminate between NASA having an internal cap at which they have this "yellow light" system which I talked about. If you reach a certain spending point where the overrun is so much or the requirements growth is so much, we stop and say, time out, let's have an assessment and see if the value of continuing outweighs the increased cost. That could come up by doing a much better forward projection.

Mr. MOLLOHAN. Would you elaborate a little bit, then, on your answer to the chairman's question about capping and apply some of the principles you have enunciated here to this specific program?

Mr. GOLDIN. I think on this specific program, what would be the appropriate form of contracting would be either the fixed-price, incentive contract, when we get into the production and we go through their review process. NASA does its assessment and the Congress could do its assessment and then we discuss it; that would be one approach.

And the second approach, which I also think we ought to consider is the cost-type contracting, where we would have this negative earned fee if there was lack of performance to ensure we had integrity in the process of the contractor when they make the bids. Those would be the two approaches I would recommend in answer to the Chairman's question.

Mr. STOKES. Would the gentleman yield to me on that?

Mr. MOLLOHAN. Yes, sir.

Mr. STOKES. In effect, when you move from development into production and you go to a fixed-cost type of contract, you are in effect capping it yourself, are you not?

Mr. GOLDIN. Yes.

Mr. STOKES. And the problem, of course, is that as long as you stick with it, we are okay, but if you come back to us with some other approach, that is where we have a problem.

Mr. GOLDIN. Yes, sir. And by the way, when you take a look at some of the other programs later in the day, you will see that NASA set out down one track and set up a whole set of groundrules and the place we got into trouble was we changed those groundrules to go do it another way.

So one of the most important things we ought to do is take the time up front and decide how we are going to do it and then stick to that approach. Because you can't take one form where I am going to build a low-cost system and have multiple units and then suddenly convert it to a contract where I am going to build only one unit and I am going to have that unit serve all the needs.

That is where I say you want to have this "yellow light" system and say, "time out," are we doing the right thing? Should we terminate and start over again or should we continue the way we are going? I think when you listen to the story on the Transfer Orbital Stage, you will see we had a well-defined \$30 million program. That turned into a \$200 million program because along the way the approach kept changing but there was no "yellow light" system to say "time out," let's see where we are. That is why I think it is so very important for NASA to have that, and I think we have that reporting responsibility to the Congress to tell them when we have this time out.

Mr. STOKES. Thank you.

Mr. MOLLOHAN. Thank you, Mr. Chairman.

Mr. STOKES. Sure. Mr. Chapman.

Mr. CHAPMAN. I have no questions at this time, Mr. Chairman.

Mr. STOKES. Mr. Torres?

Mr. TORRES. Mr. Chairman, I indicated earlier I had a number of questions to ask. I would like to seek unanimous consent from you to present these in writing to the administrator for some answers and yield back my time. I have to go to another meeting, so I won't be able to raise these questions at this time.

Mr. STOKES. The gentleman certainly may submit his questions for the record.

Mr. TORRES. Thank you.

Mr. STOKES. Certainly.

Mr. THORNTON.

Mr. THORNTON. Mr. Chairman, I have no questions at this time.

Mr. STOKES. Why don't we recess until 1:30 this afternoon. Is that all right with you?

Mr. GOLDIN. Fine.

Mr. STOKES. Fine.

[Recess.]

ALTERNATE TURBOPUMP PROGRAM

Mr. STOKES. The committee will come to order.

Before we start, I understand, Mr. Goldin, you wanted to further elaborate on the question that was posed to you by Mr. Mollohan?

Mr. GOLDIN. Yes, sir. When Tom Utsman was talking about his example of the casting and the welding for the Alternate Turbopump, I felt there was a very important point to answer Congressman Mollohan's question about how this all relates to the reforms. So let me just take a few minutes to elaborate a little bit.

When we had the recent pre-development activity, had we gone through the process, we would have made a contingency plan and identified where there were potential problem areas that are part of the general engineering process. It would have been clear we could have problems with casting, with the bearings, and with some vibrational problems we had as the cooling fluid would interact with the shaft. And we could have required as part of this process, in getting ready for a development contractor, that the two competing contractors work on those problems with tens of people.

The program had at its peak about 300 to 350 people. If you have a problem with 350 people and the schedule slips, it costs a lot of money; whereas if you identify problems early in the program, during the pre-development phase, you have tens of people on the program.

I want to solve this specific problem. I want to make a casting with small grain size and high strength. I want to understand the mechanical characteristics of the ball bearings. I want to take the vibrational problems out of the system. You could do that. You could retire the risk, if you will, and then proceed on with the program and not have the type of problems that we have had.

So I wanted to relate the technical issues to the process that we are proposing here. If we had a contingency plan, and had gone through all these contingencies, I think we would have had a much better cost assessment of how we go produce the system. And I think that was a direct answer to the question that you had asked, and a clarification I wanted to provide.

Mr. MOLLOHAN. Thank you, Mr. Chairman.

Mr. STOKES. I understand Mr. Aldrich also wants to come up and make a statement on this.

Mr. ALDRICH. Yes, Mr. Chairman. Thank you.

Since you mentioned my role briefly in the Shuttle return-to-flight, I wanted to present my opinion, which is a little different than the one that Tom Utsman expressed, about what we might have done earlier if the turbopump program had been projected at a billion dollars at the time we started it.

As I am sure you recall, during the return-to-flight we made some 200 changes to the Space Shuttle for safety and for improvements to make it a better performing vehicle, in addition to redesigning the solid rocket motors. And during that time the new system was of more concern to us than the space shuttle's main engine, to make it safer because it is a very high risk of applying the shuttle system.

Nevertheless, those changes were reviewed prudently and at the time the Alternate Turbopump came forward, it was competing with a number of other proposed ways to improve the main engine by improving the existing rocket-guiding system. I was in charge of reviewing those things at that time.

I am quite confident that if we were told that was a billion dollar improvement, it would have been way out of bounds with other options we wanted to improve, and I don't believe we would have bought into it at that time. We might, with some experience, decide we must go distinguish that kind of cost, but in that timeframe that is far different from what we thought we were buying into.

There was quite a bit of skepticism on the NASA team about the Alternate Turbopump, and we had some fairly strong presentations by the contractor about their ability to produce that pump and the performance it would provide. And it was reviewed by our Marshall Space Flight Center as part of the shuttle program to assess the technology and the issues.

And while we thought it was a risky technology, we did not think at that time we were buying a billion dollar system and I think there were a number of other avenues we would have considered before signing up.

Mr. STOKES. Thank you very much, Mr. Aldrich.

Anything further, Mr. Mollohan?

Mr. MOLLOHAN. No, sir.

MARS OBSERVER MISSION

Mr. STOKES. We will now go to our next program, the Mars Observer Mission.

Dr. Len Fisk and Mr. Diaz, I am happy to have you with us.

Dr. FISK. Thank you.

Mr. STOKES. The next program is the Mars Observer Mission.

I understand the committee was advised in 1985 that this program would incorporate a number of approaches to achieve what might be called a smaller, cheaper and faster series of missions to the planets. The committee was told that the Mars Observer Satellite could be developed for about \$300-plus million.

The Mars Program Office has put together a paper which attempts to outline what has gone wrong. Incidentally, when we take a look at the chart before us, it is interesting to note of the \$200-plus million overrun cost growth, only \$75.9 million is attributed to the launch slip resulting from the shuttle accident.

I would like to ask Len Fisk to tell us in his view what went wrong and why. For example, as the chart indicates, it cost \$60 million additional for spacecraft developments after it was moved to an expendable launch vehicle.

Dr. FISK. Thank you very much.

There are some very interesting lessons in this, as you point out, and as Mr. Goldin also alluded to earlier this morning. Mars Observer was started around a certain set of assumptions; namely, that it was a continuous program of a regular series of launches. And a number of safeguards were built into the program in order to achieve a relatively modest cost.

For various reasons, early in the program, those assumptions and safeguards were abandoned. You can see this in lots of interesting ways, because in a regular series of planetary launches, you are not highly motivated to make sure that everything is done in just one mission. You have a series of missions and you can fly instruments on different spacecraft. Whereas, in the case of Mars Observ-

er, very early on, the multi-mission concept was abandoned and it became a single mission. When it became a single mission, it was the only trip to Mars which was anticipated for many years, and so the payload became much more aggressive. The instruments became more complicated. That, in turn, led to some weight problems on the spacecraft. That, in turn, led to abandoning some of the safeguards of protecting spacecraft development against instrument development and so on and so forth.

So I think the principle lesson that we ought to remember in this is that when you start a mission under one set of assumptions, you ought to continue it on that same set of assumptions. The second lesson we ought to learn from this is there is great value in having, in fact, a regular series of missions. It allows you certain flexibilities that you do not get in single new starts.

I call your attention to the very successful Explorer program that NASA also operates which has launched now some 70 missions. To the best of my knowledge, Congress has never been presented with a cost overrun in the Explorer program. We have always managed to deal with our problems within a fixed line of that program.

So I would hope as we think of better and faster and cheaper ways to do planetary missions in the future, we would remember the virtue of the mission line approach as was proposed in the original Mars Observer concept.

Mr. STOKES. This spacecraft contract, according to the chart, is described as being a fixed-price contract, isn't that true?

Dr. FISK. That is correct. That is the contractual vehicle that was used. Of course, as I am sure you are aware, with a slip in the launch and the changes in approach here, the cost was not in fact fixed.

Mr. STOKES. I notice also on the chart you indicate or NASA indicates that it cost almost \$6 million to restore a cut of only \$1.6 million which had been made the previous year by the appropriations committee. Tell us why that is.

Dr. FISK. My recollection of that is twofold. The principal change in the costs that occurred was to restore some reserves. There had also been an additional cut, on top of the Congressional cut that occurred a year or so earlier under appropriations integrity reforms. When you look at the program at that timeframe, we were nervous about the reserves. And since we were working to a fixed planetary launch window, where the penalty is enormous if you don't make it—there is a 26-month slip if you are going to Mars—we added to the reserves at that time.

REPLACEMENT ORBITER

Mr. STOKES. Let me move to the replacement orbiter. We talked about that a little bit this morning.

In that case, the committee was able to appropriate the full \$2.1 billion cost which you referred to this morning, and partly because Rockwell had previously built two or three identical orbiters, the actual cost came in at \$1.8 or \$1.9 billion.

That would seem to suggest that if we could appropriate the full cost of a project, some of these overrun problems might be alleviated.

ed. For example, I suspect that NASA might propose one or two new smaller, cheaper, faster Discovery satellites in the 1994 budget, with each running about \$150 million.

If it were possible, and I am not suggesting that it is, if it were possible to appropriate the full cost of one of these missions, could we then get your agreement that is all the program would receive unless something happens out of the control of NASA, such as a major launch delay?

Mr. GOLDIN. Yes, it would be our pleasure to take something like that. I can't begin to tell you as I went from Center to Center, at NASA, the personal difficulties that occur as, each and every year, people have to replan a program. You know, a program plan is a very complicated task and you get it all worked out. You get the team going and they start moving and every year as you change it, it takes some of the life out of the program. I would say we would accept that approach assuming that we could start the program knowing we had adequate reserves to do it, and also understanding that, if we had a "yellow light," we would come forward and say this program may not be appropriate to continue at an appropriate time because we have a series of problems. But a design-to-cost program is really the way to go on these small measures.

We should not be in a position of funding these missions on a year-by-year basis because you will spend a larger portion of your budget replanning and with paper than building hardware. So we think that that is a very appropriate suggestion, and would be pleased to take that on.

MARS OBSERVER

Mr. STOKES. Another question on the Mars Observer, even though this program had a cost growth of the \$200-plus million including a large delay launch, isn't it true that you had to downscope the program?

Dr. FISK. There was one. The Visual and Infrared Mapping Spectrometer had serious cost overruns of its own and the potential of additional ones, and that was the basis for the descope.

It has been the policy in Space Science to make the hard decisions on descoping, if in fact instruments do run into trouble. We have done that in other programs and it is a painful process, but we do that if it is necessary.

Mr. STOKES. Thank you.

Mr. Mollohan?

BUDGET RESERVES

Mr. MOLLOHAN. Mr. Chairman, I would just like to ask you how a prudent NASA manager budgets a project and then how that should play out, if you would, in terms of reserves?

Dr. FISK. The process by which we do this can be, and should be, quite rigorous where you have gone through a Phase B activity that allows you to understand the cost elements of the program. And then you include a reasonable reserve posture and it is usually assigned actually by sub-element of the mission.

Some instruments tend to be high-risk items and carry higher reserves than, say, spacecraft that are fairly straightforward. And you put that package together.

I think, as we were just talking about in the case of Mars Observer, you also make a certain set of assumptions as to the risk that you are prepared to take in the mission, for example, the quality of the parts that you are planning to use, and the amount of redundancy that you are planning to put into the spacecraft. Those all go into your cost assumptions.

I think just relating it for a moment to Mars Observer, you have to be very careful as you execute the program that you in fact keep that same set of assumptions. Otherwise, you will encounter cost problems. And if you are going to change your assumptions, you should make sure everybody knows that as you change your assumptions, you are also going to change your cost at that time.

Mr. MOLLOHAN. Because you can't fairly take that out of reserves because it was never put in.

Dr. FISK. That is right. Our reserve is there for——

Mr. MOLLOHAN. For the initial anticipation.

Dr. FISK. That is right. Simply based on a long history of building these types of missions, you can say 30 percent reserve or 40 percent reserve even on some key instruments is a reasonable posture for just building that instrument. Now, if you are going to change the assumptions, then your reserve posture isn't right.

RESERVES FOR MARS OBSERVER

Mr. MOLLOHAN. So is a reserve a contingency fund on each element? So in Mars Observer, what did you start with?

Dr. FISK. The \$306 million estimate included the reserves at that time.

Mr. MOLLOHAN. So you started with a project that you projected to cost \$306 million.

Dr. FISK. That is correct.

Mr. MOLLOHAN. And if you had a certain program definition you said, okay, we think this is going to cost 300 minus X.

Dr. FISK. Right.

Mr. MOLLOHAN. And X equals the reserve.

Dr. FISK. That is correct.

Mr. MOLLOHAN. And then the X is divided up into parts with regard to each critical phase.

Dr. FISK. That is right. But you also give to your program and your project managers the right to move those reserves around because you are really doing this in a statistical sense.

Mr. MOLLOHAN. When you find out that you finished phase one you didn't need the reserves, then you are again asking the folks to follow up and suggest that they have extra reserves.

Dr. FISK. Even slightly differently, you may discover that something was in fact easier to do than you thought it was going to be and you didn't need to apply reserves, while something else proved to be harder, and so you assign the reserves to that. So basically you are basing your reserve posture on historical data. If you are developing a spacecraft of this type, you ought to keep that kind of

contingency and apply it judiciously to whatever problems you in fact encounter.

Mr. MOLLOHAN. You are speaking of the reasonably prudent NASA project manager.

Dr. FISK. That is right. As Mr. Goldin said earlier, we were unable to maintain the funding profiles. It comes back to your point about the virtue of being able to get all the money in a lump sum. When you can't maintain the funding profile, the first thing some do is reduce the reserves. That defines an imprudent manager, because you are going to need those reserves.

COST ESTIMATES

Mr. MOLLOHAN. Can I get to that in just a second? I want to make sure I understand the process.

So in regard to staging this particular project, the Mars Observer Mission, you followed this procedure and you were pleased you got full funding from this committee which included the reserves; is that true?

Dr. FISK. Yes. But there was one fundamental difference.

Mr. MOLLOHAN. Initially, I mean.

MARS OBSERVER FUNDING

Dr. FISK. We got full funding for Mars Observer, but the assumptions we based this cost estimate on included that Mars Observer would be part of a line of missions, and we did not get that. And I believe that was actually an Administration decision not to pursue that.

Mr. MOLLOHAN. You mean it was an Administration decision to make it one mission?

Dr. FISK. That is my recollection from 1984.

Mr. MOLLOHAN. Right there is one of the time out points; you referred to earlier, correct?

Mr. GOLDIN. That is where you would say, do you want to proceed given what has happened.

Dr. FISK. Exactly right. And if you wanted to proceed, you should have said, now, wait a minute, this is a different set of assumptions from the ones we used to price the \$306 million.

Mr. MOLLOHAN. I am just curious. When that happened did you come back and tell, for example, this subcommittee? You don't know?

Dr. FISK. I am sorry.

Mr. MOLLOHAN. I wasn't there.

Dr. FISK. I will be happy to find out. I don't know what was said in the record at that time.

Mr. MOLLOHAN. There is probably an historical memorandum from the Committee. What happened? You started adding elements and you started trying to fund out of reserves? That wasn't successful, so had you to come back in and ask for more money?

The information follows:

The decision to request funding for a single Mars Observer mission, rather than a series of Planetary Observer missions, was made by the Administration prior to the submission of the fiscal year 1985 budget request. NASA's initial request for the Mars Observer mission included solely the funding level required to achieve this single mission; it did not include outyear funding to support a series of missions.

Materials submitted to the Subcommittee between 1984 and 1988 also reflected wording that expressed NASA's hope that funding for follow-on missions would be available after the viability of the approach was proven through the Mars Observer program implementation.

Dr. FISK. I think it is even more insidious than that. Because when you discover you have a single mission, there is enormous pressure to fly everything that needs to be flown to Mars, in this case, at that time. And so the payload which was selected at that time was far too aggressive for the kind of mission we had priced.

Now, you can honestly say that more discipline should have been exerted at that time, and that is probably true, but one of the kind ways to exert that discipline is when you have a series of missions, you know, that pressure to fly everything on one mission just simply evaporates.

Mr. MOLLOHAN. When you say unable to maintain funding profile, what does that mean?

Dr. FISK. That means that—

Mr. MOLLOHAN. You, are not able to get enough money out of the Appropriations Committee?

Dr. FISK. Yes, on an annual basis. There are two crucial elements. One is the total cost. But even more crucial is the annual funding profile.

I mean, there is a characteristic development curve that starts at approximately \$30 to \$40 million, and it grows to \$100 million and it grows to \$200 million and backs down depending on the magnitude of the program. And if you don't climb up that curve, you don't maintain the schedule; and if you don't maintain the schedule, then the program slips and the total cost goes up. It is really absolutely crucial. One of your basic going-in assumptions when you price a program is how the development curve is going to look and you have to follow that closely as well.

PRIORITY MISSIONS

Mr. STOKES. Would you yield to me for just a moment?

Mr. MOLLOHAN. Yes, sir, Mr. Chairman.

Mr. STOKES. Going back to what I made reference to in my opening statement, in terms of both NASA and the Congress, we have been unwilling to take anything off the plate and we continue trying, with the limited funding we have in light of the deficit, to continue to try and keep everything on the plate instead of taking some of it off? Doesn't that get back to that same basic problem?

Dr. FISK. It does. And, as a veteran now of six years or so, I can say that there are so many more space missions to do than we will ever have dollars to do them, and the ones that are brought forth to Congress to fund are the very top priority missions, the things that we most desire to do. So one of the problems we face when you say take something off the plate, is that it is clearly a very painful thing to do because that is a mission that people have been waiting, longing to do for many years.

Now, I recognize the budget reality and I know that is going to be increasingly inevitable to do, but these missions have survived years of planning and scrutiny—beating out the competition to be done—and there is a great desire to actually carry through on them and, only as a last resort, to abandon them.

Mr. STOKES. Because inherent also in the same problem is the fact that we still don't have the funds to fully fund all of these programs. And of course Congress has to take its share of the blame here because there are times when politically they can't afford to take things off the plate either.

Dr. FISK. True. I have just one thought to try and give you some comfort. The real virtue of this "blue-team/red-team" exercise that took place over the last year has been to take the costs of ongoing programs down to a much more manageable level.

And, in fact, my recollection is that in the fiscal year 1994 budget some \$600 million was in fact taken out of ongoing programs as part of this routine exercise to try to fit them in a funding profile which was attainable. I think that is an effort that should be commended because it is a recognition on NASA's part that we had to bring these programs down to a funding level which was far more realistic in the current environment.

Mr. STOKES. May I ask how much of that was taken out of reserves?

Dr. FISK. None. The reductions were not in reserves, but rather in scope, and through increased efficiencies. I think we have briefed the Committee, on other occasions, perhaps, on the changes in missions like Cassini and the Advanced X-Ray Astrophysics Facility (AXAF), and those are some of the changes in the way the program is to be done in order that they fit in a funding profile, and the reserve posture for both is very healthy.

Mr. STOKES. I am going to yield back, but Mr. Goldin I think, wants to respond.

Mr. GOLDIN. I just wanted to say one of the other things we did was that we took a look at the total balance of programs we had. There was one program in there that was just increasing at an enormous rate, and that was Mission to Planet Earth and that program was going to be spending \$11 billion over a seven-year period.

We took a good hard look at that and made a conscious decision that given the amount of funding that we saw coming with a flat budget, we felt we could meet the intent of Mission to Planet Earth while at the same time spend \$3 billion less within the decade. That was a combination of efficiencies, and let me tell you what an efficiency means.

After we built the first platform, we said all platforms after that point would be the same spacecraft, rather than building different ones as we went along, and we tried to get efficiencies that way. Then we took instruments off the platforms before we got into this cycle of having to develop risky instruments and spending the money. So we at NASA did make some decisions to not do things as part of this "red-team/blue-team" activity. It wasn't total programs, but it was portions of programs.

Mr. STOKES. Off the record for a moment.

[Off the record.]

Mr. STOKES. Back on the record.

Mr. MOLLOHAN [presiding]. What is scope?

Dr. FISK. "Scope," as I am using the term here, is essentially the content of the program. In other words, it is anything from the requirements for what you are trying to do, to the hardware that you

are trying to build. If you remove an instrument, you would "descope" in the NASA parlance.

COST REDUCTIONS

Mr. MOLLOHAN. As part of the blue-team/red-team efforts, were they involved in the process of seeing how NASA could reduce costs in these programs? In other words was it a critical review of programs from a cost standpoint?

Mr. GOLDIN. Let me just say it was more than that. We wanted to understand how we, NASA, could start managing better. So it was not just a question of reducing costs, but identifying what steps we have to take in order to reduce costs. So one of the products of the review was the series of reforms that I summarized to you up front. Another product of the review was determining what things we should do in terms of reducing costs by cutting scope out, as Len just defined it, but all coming back to a basic set of operating principles.

We felt we could not get these savings unless, as Len said, a set of rules was set up front, and we then operated according to those rules. Because if we change those rules, we will then have cost increases again. That is why it is very crucial to us that through 1994, we set up pilot programs that test each one of those reforms that we talked about, interact with the Congress and White House, get a consensus on them and move out and put them into place and hold to them. Otherwise, we would not achieve the results we set.

Mr. MOLLOHAN. Was one of the rules of the blue-team/red-team exercise not to affect costs by reducing reserves?

Dr. FISK. The answer is yes, there was. I would have to think in some detail here. There were some programs which, when we made the changes in scope—let me be very specific—

Mr. MOLLOHAN. Sure.

Dr. FISK. An example is when you go to the version of the Earth Observing System (EOS) in which your third and fourth platforms are all the same as the second one you build. Clearly, you can have fewer reserves on those subsequent platforms because they are simply copies of the first ones. Those kinds of adjustments were made, but the reserve posture was exactly what you would expect for that area of the development program.

FUNCTION REDUCTION

Mr. MOLLOHAN. But it was still fair game to take some function off of a mission?

Dr. FISK. Let me give you an example. It may help here. In the case of the Cassini, when it was part of the CRAF/Cassini program, it was an all-purpose outer planet spacecraft and could be used for multiple applications. The decision was made in the interest of saving funds, basically, to make it a Saturn-unique spacecraft, and by making it a Saturn-unique spacecraft, remove certain articulated platforms on it and various other devices and save substantial funds in doing so and still accomplish the Saturn goals.

Now, we did make a policy decision basically that this spacecraft was not going to be used in multiple applications beyond that. But nonetheless, that was a policy decision that was taken and the con-

sequence was a substantial reduction in the fiscal year 1994 budget request.

Mr. MOLLOHAN. So you could not touch reserves, but you could touch scope, in effect taking-off capability.

Dr. FISK. Exactly. In fact, Mr. Diaz just reminded me we actually increased the percentage of reserves of Cassini as part of the "blue-team/red-team" exercise.

Mr. MOLLOHAN. My point is, one of the rules is you don't invade reserves as a general proposition. You could reduce function, for lack of a better word.

Dr. FISK. Right.

EFFECTIVE MANAGEMENT PRACTICES

Mr. MOLLOHAN. So the other issue you could address was in management—do the same thing but manage it better.

Dr. FISK. Right.

Mr. MOLLOHAN. I think it is good that in the red team/blue team exercise that you would not touch the reserves. I would think that reducing capability should be fair game. But the first thing you would really do in such an exercise would be to attempt to maintain the same scope at the same costs by effecting management efficiencies.

You haven't talked about that. Was management efficiency a primary goal? To what extent did management issues play a part of it and to what extent did you reduce the overall cost by decreasing the scope of the total mission?

Dr. FISK. This was a multi-pronged attack, because we had some very ambitious goals ahead of ourselves in terms of reducing the costs. In the case of management reforms, there were numerous ones. But let me give you some of the prime examples.

In the case of Cassini, a program managed by NASA's Jet Propulsion Laboratory (JPL), we actually changed the manner in which JPL does business. We reduced the size of design teams. We changed essentially the overhead at JPL. Remember, JPL is unique in that they are not civil servants, so the cost of JPL salaries is incorporated as R&D costs. So we do see the management overhead at JPL is a significant cost item on these programs. What we found on examining this was that you had a mission team at JPL, which in turn interfaced with a technical division which had its own infrastructure and overhead. And finally you got down to the people that actually did the work, and by cutting out that overhead associated with the technical divisions, there was substantial savings of some 750 man-years associated with the Cassini project over the lifetime of the project.

In the case of AXAF, it was a different approach but a very similar intent. AXAF was split into two spacecraft, but for the spacecraft that is being managed out of house by Marshall Space Flight Center, the imaging portion of AXAF, we are changing the contract in structure and the management oversight at Marshall; the oversight required to administer this new contracting structure is substantially less.

So in both cases we enhanced efficiencies, made scope changes and changes in the ways we were doing business; and of course,

when you are looking for the amount of cuts we were looking for, you have to do all of those things.

Mr. MOLLOHAN. Did the red team/blue team affect virtually every program in NASA?

Mr. GOLDIN. It touched every program in NASA, and we have completed what we consider Phase 1, and we are stopping to pause now and say, what are the lessons learned? Did we have a good process? Did we improve the process? We intend to institutionalize this approach at NASA. We also believe that change will not occur in a year. If you take a look at modern management theory, change within an organization, to really change a culture and affect that culture, takes about three to five years. If you look at major American corporate turn-arounds, you can do some very, very fast razzmatazz and changing people, but the real effect comes at getting the cultural roots of the organization. There are hundreds of small issues. It is not a macho thing where I can take a knife out and immediately affect huge things, but it is hundreds of small things. And it affects a lot of people, and we have literally hundreds of people moving around the country and having meetings in each and every area of NASA.

Mr. MOLLOHAN. Is \$600 million the amount of savings you have affected in this process?

Dr. FISK. We will answer for the record, but that is my recollection.

Mr. ALLISON. It was billions of dollars.

Mr. GOLDIN. We did it over a five-year period.

Mr. MOLLOHAN. Fiscal 1994.

Mr. ALLISON. Still, a couple of billion.

Mr. GOLDIN. A couple of billion dollars.

Dr. FISK. When I mentioned \$600 million, I was talking about reductions in space science missions only.

Mr. GOLDIN. That was over the five-year period. We could correct that number for you. But it was a very large number.

Mr. MOLLOHAN. That would be interesting for the committee, I am sure.

[The information follows:]

The Red/Blue Team exercise was a unique opportunity to start an important critical self-evaluation along with a comprehensive review of all the agency's major program areas. It focused on identifying requirements which could be eliminated, efficiencies which could be incorporated, and ways to make NASA's programs better, faster and cheaper. The "Blue Teams" reviewed the current programs to look for significant savings. The "Red Teams" acted as "devil's advocates" to make sure all options were thoroughly examined. In some cases, the recommendations of these teams were quite dramatic. The Cassini and Advanced X-Ray Astrophysics Facility programs were significantly restructured, and the Earth Observing System rescope, dramatically lowering the total cost of each of these projects. In other cases, the teams lowered the operational costs of many programs, through implementation of management efficiencies, changes in contract structure or new ways of doing business. For FY 1994, total funding for NASA was reduced \$1.8 billion, from \$17.1 billion included in the FY 1993 President's budget to \$15.3 billion included in the FY 1994 President's budget. For FY 1995-1997, total funding requirements were reduced approximately \$10 billion.

PROGRAM SAVINGS

Mr. MOLLOHAN. Which program experienced the greatest savings? Is there some spectacular example of success on this process?

Mr. GOLDIN. I think shuttle program was the largest savings we had. When he got through with the process, Jed, over the three year—

General PEARSON. Twenty-five percent in operations, but it was a huge team effort and the people in the shuttle program were committed, while we have not compromised safety. And within the savings they have, they have proposed to do upgrades to the Shuttle to improve the safety. So I think that was the largest reduction we had.

Mr. GOLDIN. The Shuttle, before the "red team/blue team," had committed to reduce 3 percent a year over a five-year period. Jed signed up, after the "red team/blue team" to 25 percent over the three years.

Mr. MOLLOHAN. Without any consideration of cutting anything that would be considered a diminuation of safety?

Mr. GOLDIN. In fact, to improve the safety. In fact, in these two numbers was a large throat engine which will allow us to operate the system at a lower level. In fact, within those numbers was the Alternate Turbopump and the advanced avionics for the Shuttle and a new power head.

KSC STAFF REDUCTIONS

Mr. MOLLOHAN. The staff just said that you are dramatically reducing staff at Kennedy. Where are those reductions coming from?

Mr. GOLDIN. Jed, do you want to come speak to that?

General PEARSON. A lot was in the contractor and the servicing of the Shuttle between missions, cutting back on the number of people required to do that. That is where we have gotten most of our cutbacks, cutbacks in the people that are working on the external tank and on the engines. And we are surveying that even as we speak to keep finding these economies because I have signed up to the Administrator to continue reducing the costs. But beyond that, I am also committed to flight safety. That is the number one objective, and all my waking hours are devoted to that.

Mr. MOLLOHAN. If you can ascribe that to safety. Just sitting here and reacting to that, I would have to suggest that if you can't ascribe at least some of the savings to safety, in a way that is quite an indictment of the way you operated before.

Mr. GOLDIN. I would like to address that subject rather than looking at it as an indictment.

Mr. MOLLOHAN. Maybe that was a harsh word.

Mr. GOLDIN. Well, it is very, very important to understand that American corporate culture is undergoing tremendous change and we in America had set up a specific way of doing business which became very, very rigid. When we started out in the 1970s, we went into the 1970s with tremendous optimism about how America was working, but something silent was happening in the world. At the end of World War II and the Korean War, we had an infrastructure that was in place so our products were selling worldwide. The rest of the world said, My God, we have to build new infrastructure because it was devastated. There was a silent period of about 20 years. So the mid 1970s come along and these new compa-

nies started building new infrastructure and new management techniques.

So what happened here, was that America, not just in government but in industry, was asleep at the wheel. What was happening in this revolution worldwide and this consciousness—some call it total quality, or quality circles—came along to say there has got to be a better way. And one of the things that they did down at NASA-Kennedy, which I think is really excellent and it is a very painful process, I mean, was to invite committee members and staff to come down and meet with Jay Honeycutt, who is a leader down there. They went through each and every process they have and they laid out these huge flow charts and said, what is each of the work activities in these processes, and say, given that, we understand how the process works, how could we eliminate these steps and cut back on cycle time and eliminate work?

I view this as a real positive step, not an indictment. It is a very important point to note because people take tremendous pride in their stepping up to this. And again, it is not one big victory, but hundreds of people working thousands of hours to really get the program to come together, and they have maps where they plot their product activity on a weekly basis and they show how quality is improving. In fact some of the charts you are seeing at Kennedy show the integration returns are going down because we are getting better quality, so it is a paradox. So as you make the quality better, the cost seems to be coming down. I didn't want to be argumentative, but I wanted to give you that perspective.

Mr. MOLLOHAN. No, nor did I, and I should have thought of the possibility that there were productivity improvements before I thought that there was overstaffing.

General PEARSON. As an example, processing time is down from almost a hundred days to about 55 days now.

STATUS OF MARS OBSERVER PROGRAM

Mr. MOLLOHAN. What is the status of the Mars Observer Program 1994?

Dr. FISK. We are en route to Mars. We launched last September, and we are having a very successful, uneventful flight, which is what you like. And if all goes well, we will stop at Mars in August of this year and then go into orbit. The prime mission, two years in length, will consist of continual mapping of Mars, and probably will be extended beyond that. Assuming it is a successful mission, which we have no reason to doubt—

Mr. MOLLOHAN. So far it is a real technical success?

Dr. FISK. It is an absolute technical success.

Mr. MOLLOHAN. Mr. Lewis.

Mr. LEWIS. Sorry that I was delayed. It seems it was the speaker having lunch with people on St. Patrick's Day and I couldn't avoid it. I am sorry.

Mr. GOLDIN. No problem.

COST OVERRUNS FOR MARS OBSERVER

Mr. LEWIS. I am sorry I missed the testimony, but I have had a chance to review some of that. It would seem from prior agency

testimony that the primary source of cost overruns for Mars Observer was being overly ambitious in the selection of instruments to be flown on the satellite. You ended up deleting two of the instruments, the visual infrared mapping spectrometer and radar altimeter. Is that right, those two?

Dr. FISK. That is right.

Mr. LEWIS. It is the nature of these programs that you encounter substantial risks and considerable uncertainty. In retrospect, was there anything that could have been foreseen with regard to those instruments?

Dr. FISK. Well, let me go back on this thing. I think the fundamental issue—

Mr. LEWIS. I am sorry if I missed part of it.

Dr. FISK. I am happy to paraphrase what we talked about. The primary issue I think with Mars Observer was that we designed the program as a series of missions and in fact executed it as a single mission. And there are some insidious things that happen when you only have one spacecraft and it is the only one going to Mars for several years. You tend to choose an ambitious payload, and that in turn ricochets through the program, as you stated.

So I think, if you could back up, the best thing to do would have been to execute the program as it was intended, which was as a series of missions. You would reduce the pressure to have a particularly ambitious payload. We would have had a series of missions going to Mars or other planets, and then we would have had a lot less difficulty with cost. Conversely, we should have either priced the program as a single mission with an ambitious payload, or we should have exercised great discipline and in fact not chosen such an ambitious payload given that it was a single mission with no relief coming from a series of missions. The assumptions in the Mars Observer program were good ones and the original program should have been followed.

Mr. LEWIS. Mr. Goldin, as you look back on this, does this fit then the model that you would suggest your changes in administrative style and contracts could achieve?

Mr. GOLDIN. I believe it would have been very effective, especially when a decision was made to go from a multiple series of spacecraft to a single spacecraft, to have triggered this review process, which would have caused us to really sift through the issues about what the implications were financially. There would have been an independent assessment of that implication financially by the people who didn't have this burning desire to go to Mars. They would have taken a look at some of the realistic cost effects. And that would have caused us to have a discussion about whether we were going in the right direction. So I believe it would have had a very positive impact.

Mr. LEWIS. Dr. Fisk, how would you react to that?

Dr. FISK. I think that is right. In fact, I am very comfortable with that. In a lot of these new missions that we are talking about, the Discovery series and so forth, we are talking about them as a series. We really believe in the virtue of a frequent set of launches to the planets because of the flexibility that that provides and because it avoids having everything riding on a single event. So I think when you talk about small mission programs in which you

want to do them as cost effectively as possible, the virtue of a line of these missions is very valuable. And before you came in, I was reminding people that in the Explorer program, of which we have now launched some 70 missions, Congress has never, to my recollection, received overruns on that program that we have not accommodated ourselves within the fixed line item.

Mr. MOLLOHAN. Mr. DeLay.

Mr. DELAY. I have no questions.

Mr. MOLLOHAN. The Chairman prefers that we not go on to the next series of questions, so we are going to give you an opportunity here to involute a little bit.

You talked about attributing the \$60 million additional costs for the Mars Observer when it was moved from the shuttle to an ELV. Is that correct?

Dr. FISK. That is a high number. The total number that covers the two-year launch slip and switching to the Titan III launch vehicle was around \$90 million. It was the sum of \$76 million and \$18.8 million; so that is the total cost associated with the slip. And as always in these programs, you have to be careful whether you can unravel from that number things that are exclusively driven by the launch slip and the switch to the Titan III. Because if you have had other problems in the program along the way, when you have a launch slip and it causes a cost increase, other things can be taken care of at that time; and you have to unravel from that what that cost is. That, of course, is a difficult exercise in retrospect. But in any event the total bill associated with the two-year slip in going to the Titan III was around \$95 million.

Mr. MOLLOHAN. In this instance you were encouraged to, were you not?

Dr. FISK. The two-year slip?

Mr. MOLLOHAN. In part to provide a market for the ELVs?

Dr. FISK. I think there are two things that happened. I mean, the slip occurred primarily as a consequence of the Challenger accident, in the following sense: Remember that Space Science basically took a \$1 to \$2 billion hit as a result of the Challenger accident. Missions slipped and so on, and there was a great deal of uncertainty in 1986, 1987, 1988 and even 1989 of being able to accommodate all these missions. Some of them were easier to slip than others. Even though in theory Mars Observer didn't have to be slipped, it was slipped mainly as a budgetary issue in order to provide resources to maintain the other missions that were being delayed by the Challenger accident. So that is why you get the two-year slip.

The decision to go to the Titan III was essentially the result of a change in national launch policy. Following the Challenger accident, it was decided that missions that did not need human assistance were going to be launched on ELVs.

EXPLORER PROGRAM

Mr. LEWIS. Dr. Fisk, if I could, you mentioned the Explorer line in the budget and indicated that no overrun has ever been taken to the Congress on Explorer.

Dr. FISK. That is my recollection. I hope you are not about to contradict me.

Mr. LEWIS. Doesn't that statement need some clarification because if an individual Explorer satellite incurred an overrun we would never know it since it is hidden within a roughly 120 million Explorer line item?

Dr. FISK. That is fair. We have flexibility in the program to essentially use all our variables. You can use schedule. You can use scope. And—

Mr. LEWIS. If you increased the line item \$5 or \$10 million, you could quite easily cover a significant overrun, couldn't you?

Dr. FISK. Certainly if you add to the line item, you could.

Mr. LEWIS. And we wouldn't necessarily know it?

Dr. FISK. Excuse me, the line item is something you control. And in fact you have at times augmented this program because we have agreed to put more missions on it.

Mr. LEWIS. We wouldn't necessarily control it in that detail?

Dr. FISK. Yes.

Mr. LEWIS. We would have the requests for funding but we wouldn't know specifically what it was for.

Dr. FISK. That is fair. But we tell you what it is in that line. You get a breakdown of what is contained in the \$130 million. But NASA does retain the flexibility to move and mix and match missions in there to get the maximum content out of that \$130 million.

Mr. LEWIS. But your testimony essentially is to say then, that you have not brought to the Congress an overrun on Explorer and you have made every effort to let us know if there was an overrun?

Dr. FISK. You always see the total breakdown underneath that \$130 million figure. There has been sort of a "handshake deal" with the Congress over many years in that we would not ask for increases in this program and we would not cut the program, and you almost never see us use that money for anything except the Explorer missions. And the consequence has been 70 successful missions. I mean, it is the largest single program of successful small spacecraft missions, essentially dating back to the beginnings of the space program.

And one of the things that you get from that is that, on any individual mission, you can in fact maintain a minimum set of reserves because you have the flexibility within the line item to mix and match between them to get the maximum value out of it. So when you have a single mission controlled by a single line item, then you had better make sure you have all the money you need in that line item, and what you tend to do is have fairly aggressive reserves for a full, new start; whereas for programs within line items, you can be more aggressive in how few reserves you have and play off the other missions against each other to get the maximum value. And I think the lesson to be learned from the success of the Explorer program is that for small missions a series of missions that is a good system.

Mr. MOLLOHAN. We will take a recess until the chairman returns and he should be here momentarily.

[Recess.]

NEW ORBITER FUNDING

Mr. STOKES. Mr. Goldin, a few moments ago we discussed the advantage of fully funding the new orbiter and perhaps one of NASA's new starts in 1994, but it would appear, if we had fully funded Mars Observer exclusive of the accident delay, NASA would still have incurred a major overrun; is that a fact?

Mr. ALLISON. Yes, that is correct.

Mr. STOKES. The answer then is yes?

Mr. ALLISON. Yes.

TRANSFER ORBIT STAGE

Mr. STOKES. Let's go into the next program which is Transfer Orbit Stage (TOS). Here again we have a program that was advertised to the Congress as a new upper stage that would be developed privately and would cost approximately \$40 million a copy. As we speak today, the per copy cost is over \$100 million.

Now, we recognize that some of that cost growth is attributable to delays in Advanced Communications Technology Satellite (ACTS) launch dates, but that is not the primary driver of the cost growth. As the chart suggests, there were a number of technical and safety changes.

Can you tell us what, in your view, has gone wrong here?

Dr. FISK. I am going to answer this, and Charlie Gunn is also going to appear with me to back me up on this. You know, TOS is one of those programs which is hard in some sense to learn lessons from, because the assumptions on which the program was started have been drastically changed over the years by, basically, policy decisions. TOS was started at a time where, as you point out, it was to be a commercially-developed upper stage with very minimum government oversight. The number of people that were assigned by NASA's Marshall Space Flight Center, for example, to watch this program were in the handful, as opposed to any great penetration.

Orbital Sciences Corporation (OSC) was the manufacturer of TOS, and assumed that they would develop a business base of commercial launches from the Shuttle. Then you say, well, where are we today?

Well, we are not launching commercial satellites from the shuttle. That was a policy decision. We are not tolerant of not being able to penetrate into a commercial program because of the safety concerns on the shuttle. All the assumptions which they started with have changed either as a result of the Challenger accident or as a result of a change in national launch policy from using the shuttle as the single launch capability of the Nation.

We do have a very successful launch stage now and the corporation, OSC, invested substantial sums of its money in the development. The Government really did not do the development of this; we bought the copies. But nonetheless the comparison from the beginning of the program to the end is clearly a very difficult one because the assumptions are simply very different today than they were when it was started.

Mr. STOKES. Orbital Science is under contract; is that right?

Dr. FISK. That is correct.

Mr. STOKES. When Orbital, is offering a bargain basement price for any TOS upper stage, is that NASA purchases over and above Mars Observer and AXAF? Can you tell us what that bargain basement price is?

Dr. FISK. I am not sure I know the answer to that. The reason I want to be careful is that any upper stage we might buy in the future could be competitively procured. I mean, there is no intention to sole-source procure this upper stage. So should we use an upper stage, for example, on AXAF, we would contract for it through a competitive procurement. And it is probably wise to let the competitive process occur and then report on the price that they actually bid.

The other thing that we have to be careful of here is that \$50 or \$60 million for hardware would be a number that I would expect. However, when we adapt these upper stages to particular spacecraft, whether it is in terms of the avionics, whether it is in terms of the guidance control system, whether you have to add engineering loads or make other changes in the launch vehicle—all of these have costs associated with them. If you want to know what it is actually going to cost each time you launch it, you have got to add all those things in; and we would know that only as a result of the actual competitive procurement.

PROCUREMENT AWARD FEE PROPOSALS

Mr. STOKES. I would like to ask the Administrator to tell us how new procurement award fee proposals would operate in the case of this program. TOS is, after all, a production-type program in that you are buying additional copies of essentially the same vehicle.

First, tell us what would the third buy be, fixed price? Second, how would any overrun be treated relative to the award fee?

Mr. GOLDIN. Let's say the following. We might have a production build, a build to print, if you will, where we take the prints that for the second unit and to the third unit. We would most probably go with the fixed-price incentive contract. With regard to the fixed-price, the basic cost of the contract is up to the contractor, and the incentive would be set up so that if the stage worked, they would get their profit. If it did not work, we would arrange it so that there would not be a profit for the corporation that built that stage.

Mr. STOKES. Thank you.

Mr. Lewis.

COMMUNICATIONS SATELLITES

Mr. LEWIS. Mr. Chairman, I am not really sure that I have any questions, but would somebody review for me the history of how we got to the point of having communications satellites not a part of a shuttle payload?

Mr. GOLDIN. Len, do you want to go through that?

Dr. FISK. Yes. Prior to the Challenger accident, basically the Shuttle was intended to be the sole launch capability of the country in many regards, and we launched commercial satellites, we launched military satellites, and we launched science satellites.

Following the Challenger accident, in about early 1987, I have to think of my exact timing on this thing—basically, policy decisions were made to develop the “mixed-fleet” concept. The mixed-fleet concept held that the Nation would not rely on a single launch capability. It would rely on multiple launch capabilities, including both the shuttle and expendable launch vehicles.

As part of that policy, NASA essentially got out of the business of launching commercial satellites. Of course, having commercial satellites launched on ELVs, which is a very appropriate way to do it, provided a business base for commercial ELV business; and so it sustains the mixed fleet concept by not having the government in the commercial satellite launch business. And personally I think it has been a very wise policy, because you clearly do need multiple ways to access space, and the available business should be spread across the various launch vehicles so we can maintain a broad, stable, diverse launch capability.

Mr. LEWIS. I remember taking my father to the construction site of the local firm from San Bernardino to cut the ribbon on that launching facility in California.

Are we using that for shuttle launches?

Dr. FISK. You must be referring to Vandenberg Air Force Base. I am not familiar with California geography so it took me a second to realize what you were referring to.

Mr. LEWIS. I am trying to remember what actually happened with that.

Well, Charlie, you must know.

Mr. GUNN. It has been mothballed.

Dr. FISK. It has been mothballed and never used as a shuttle launch or landing site. Of course, the Air Force continues to launch expendable launch vehicles out of Vandenberg. Titans and Deltas are launched out of Vandenberg, and the U.S. Air Force is opening up a new capability in the medium-range launch vehicles.

Mr. LEWIS. I do remember how thrilled my father was to see that magnificent development. He was a contractor himself as a young man and it happened to be a sidekick of his who did the cutting of that ribbon. It was good for the economy of San Bernardino, even though it is a long ways from Vandenberg.

I would sure like to have somebody brief on that whole process of how we decided to mothball what is essentially a brand-new facility.

Dr. FISK. We would be pleased to send someone. I think whoever comes up to talk to you about that will be from the Air Force, given that it is an Air Force facility.

Mr. GOLDIN. We need to make special arrangements to brief you on that.

Mr. LEWIS. I am on the right committee now.

Mr. GOLDIN. We understand that and we will make an arrangement. Let me just give you one piece of background information. Because of its geography, Vandenberg is mainly used for North-South Polar launches; and Kennedy is used for East-West equatorial launches for the most part. And as a result, there is a very significant desire by the Air Force and the military to use Vandenberg probably more so than NASA, and I think we can get into more detail.

Mr. LEWIS. Somewhere within this record I would like to know whether this kind of decision-making process has allowed us to be more or less competitive in the world marketplace as it relates to launching.

Mr. GOLDIN. OK.

TRANSFER ORBIT STAGE

Mr. STOKES. Mr. Mollohan.

Mr. MOLLOHAN. Thank you, Mr. Chairman.

TOS is different from the other case studies, in a couple of ways; Is that correct? First of all, it is a private sector project.

Dr. FISK. That is right and there are a number of differences. We need to be very careful when we compare the \$39 million figure with the final cost of \$200 million, because the implication is that the change was all cost growth. In fact, we purchased a lot of extra things. The original contract was for just the hardware for Mars Observer. Then we contracted to do the integration for Mars Observer. Then we contracted to do the hardware for the ACTS spacecraft and the integration for the ACTS spacecraft, and then we changed the rules on flying on the Shuttle.

Mr. MOLLOHAN. Is that as a result of Challenger?

Dr. FISK. Yes. Then we decided that in the case of Mars Observer we needed this upper stage, not for the Shuttle, but for a Titan III; so you have a whole series of scope changes, to use our other term. So the comparison of the beginning cost figure to the end figure in its simplest form is a misleading one. You have to go through what in fact you added to the program.

But if we are using this hearing to find lessons, this is a tough one to learn lessons from because so many of the rules changed, between when the TOS program was started and today.

Mr. MOLLOHAN. Maybe this is an example to distinguish a situation in which you have scope changes that are all legitimate and necessary.

Dr. FISK. That would be simplistic in the other direction. There are also overruns and issues. I think this is a case, again, where along the way somebody should have stopped and said, "Let's make sure we are all together, and this is the right course of action." We might well have done that because we were depending on this launch vehicle for missions like Mars Observer, which had a fixed launch window we were working to. But at the very least there should have been a re-baselining of this to say, okay, these are new rules for this program, and in that context, this is what we expect it to cost.

MANAGEMENT PROBLEMS COST OVERRUNS

Mr. MOLLOHAN. Just looking over this budget history, nothing jumps out at me as being a particular example of cost overruns. Where would the management issues leading no cost overruns be found?

Dr. FISK. In our analysis of this, if we go down and say: When did we buy new hardware? What did the Challenger accident do to us? When did we look for more redundancy, because we are now not tolerant of failures in the way we were before—we find somewhere

around \$20 to \$35 million of what you might call overruns, which were really development changes.

But I think it is very hard to sort out real cost overruns, because you have got so many things going on, including schedule changes. I mean, even here you have a corporation that did all this on the assumption that they would have a regular base of business from which to amortize their development costs, and that business base did not materialize when the commercial launches on the shuttle were no longer available to them after the change in national policy.

So you have got all those issues in here which cloud any simple analysis of this particular one.

Mr. MOLLOHAN. I know you are giving rough numbers there. Would you characterize going from shuttle to Titan as part of that \$25 million?

Mr. GUNN. No.

Mr. GOLDIN. Charlie, why don't you walk him through?

Mr. MOLLOHAN. Give me some examples of the cost overrun part in this budget history.

Mr. GUNN. Going back to your original question, the transfer of the Mars Observer from the Shuttle to the Titan III cost about \$13 million of this total increase of \$175 million.

Mr. MOLLOHAN. I am looking for what you would consider, in the most objective way you possibly can, to be cost overruns in this history and you have been very objective here today. I was asking, as an example, whether you would consider that to be, and I don't think you would.

Mr. GUNN. No.

Mr. MOLLOHAN. What would it be then?

Mr. GUNN. We were just buying production units, and we are on a share line; and because OSC was developing the TOS, and concurrently was developing or building the units on the production line, when the safety changes had to be made, a lot of the production hardware had to be retrofitted and the program was stretched out.

Mr. MOLLOHAN. The safety changes occurred because you were putting a special piece of equipment on TOS, Mars Observer, and you didn't want to risk it?

Mr. GUNN. We had a higher demand for probability of mission success. We also had to make some changes to be sure we would be able to launch in this very narrow launch window, that occurs for only 20 days every 25 months or so.

Mr. MOLLOHAN. Is that in this cost overrun or this increase category?

Mr. GUNN. Yes.

Mr. MOLLOHAN. The reason is that you didn't anticipate such issues to begin with. Is that correct?

Mr. GUNN. Yes.

Dr. FISK. That is correct. So I think you can distinguish between cases where we have mandated changes due to shuttle safety requirements and that's what Charlie Gunn was referring to. In today's environment, we are a lot less tolerant of failure, and so you add redundancy into the program.

Let me give you a simple example. We insisted on trying to track this thing during the launch, so we put transmitters on the TOS

vehicle that in theory would allow us to try to make sure we had data during the launch. Because we wanted to make sure we were successful or know why if we weren't.

Mr. MOLLOHAN. What I am sensing here is that a lot of what turns out to be cost overruns, using that term very loosely, is turning out to be costs that are unanticipated; simply the initial process was not rigorous enough to anticipate or not the right kind of process to anticipate what the actual cost would be.

If you had gone through that process, the whole project may not have cost less in the final analysis, but there would not be any surprises about it.

Dr. FISK. Yes. I think you can say that. Let me elaborate here just a bit, and others may want to contradict or reinforce me.

You can have two kinds of problems. You can have a very simple system in which you don't anticipate something—and, in fact, you have to make changes or the rules change, and you have to do that. And so you say, well, if I had known that in the beginning, I would simply have priced those changes into the program. It wouldn't cost any less to do this thing, or more to do this; or I wouldn't view it as an overrun, because I would have told everybody in the beginning, this is what it is going to cost.

You, then, however, have a slightly more complicated problem occasionally, which Mr. Gunn referred to. You may discover a technical problem along the way, and you have to solve that technical problem; but because you have a lot of other people working on the program at that point, who have to wait while you are solving that problem, you may get a bigger bill to solve this technical problem at this later phase of a program than you would have gotten if, way back in the beginning, you had recognized that this is something that you had to solve, and in fact had solved it or planned to solve it.

Am I making myself clear? I think in the case of TOS, it was a very simple program in some regards, and most of the overruns are of the first category. There simply are things that changed along the way or rules that we decided were going to be different.

We paid for them then. If we budgeted for them, it wouldn't appear as an overrun. It appears as an overrun because we didn't budget for it.

Mr. MOLLOHAN. Unanticipated events like the Challenger accident dictated other changes that you couldn't anticipate.

Dr. FISK. There are other programs where you encounter a technical problem along the way. You have got a marching army of contractors, so your problem is bigger than it would have been had you properly anticipated the problem at the very beginning.

Mr. GOLDIN. I agree with those categories, but I come back to two basic principles of the reforms. Reform number one is, make sure you work on the requirements early on. For example, if you are going to use a TOS for the Mars Observer, decide before you come out with the Request for Proposals whether you want to have a high reliability or a low reliability, whether you want to have telemetry tracking as you do the launch or not; decide that at that point in time. Go through a process, it is called a "fish bone" process, I think a Perot chart. You go through a systematic process, not Ross Perot.

Mr. MOLLOHAN. That is what I was thinking.

Mr. GOLDIN. You go through a systematic process to try to anticipate where the problems are and spend your money solving the problems when you don't have a large number of people on the problem because, generally, solving problems is not expensive, but paying the people waiting for the hardware is very expensive.

Mr. MOLLOHAN. I think that what is very important—coming out of this proceeding is an understanding by this subcommittee, Mr. Chairman, about different kinds of cost growths, with a broad brush categorized as "cost overruns." Then we can try to isolate those issues that are really management problems.

I would just real quickly like to inquire about one other issue. This was a venture where a commercial company developed a piece of equipment and then sold it to NASA. I am just curious. What was their experience with this? Was this a pleasant experience? Was it a profitable experience? Did they say, "boy, this is great"?

Dr. FISK. I don't feel comfortable giving an answer on that.

Mr. MOLLOHAN. You don't want to speak for them? That is fine.

Dr. FISK. I don't want to speak for them.

Mr. MOLLOHAN. Whether it was a success or not?

Dr. FISK. I really wouldn't want to comment for OSC.

Mr. MOLLOHAN. Thank you, Mr. Chairman.

SPACE STATION COST HISTORY

Mr. STOKES. I might just say that the basic reason we selected the six areas was for the specific purpose, so that we may put them in the proper perspective as we look at the totalities of problems. Now, I guess we are asking Mr. Kohrs and Arnold Aldrich to come back.

We turn to the next program selected which is Space Station. We prepared a number of charts for the purpose of discussing the Space Station cost history.

The first chart is a kind of overview that covers the last three years in the 1994 OMB submission. Let me point out one or two things relative to this chart.

On NASA's projected run-out for the Space Station program in fiscal year 1991, the committee was aware we would have to appropriate over \$3 billion annually in the out years in order to meet the total program cost, as the chart indicates, of \$38.3 billion. The committee directed that NASA take a look at restructuring the program in 1990 to bring down that peak funding from over \$3 billion annually to something on the order of \$2.5 billion.

Incidentally, as it has turned out, given our very tight discretionary budget numbers, the committee has not been and probably would never be capable of appropriating even \$2.5 billion annually for a Space Station without impacting virtually on every other NASA program.

But, in any case, as the 1992 column on this chart indicates, the agency took about \$7 billion out of the program. However, as the chart suggests, virtually all of the cost savings under the restructured programs come from reducing station operations and reserves. Is that correct?

Mr. KOHRS. That is correct. In fact, the development costs actually went up a billion dollars during that timeframe because, as Len Fisk described, we stretched the program out an extra 26 months to achieve permanently manned capability (PMC) when we did the restructure. We actually had to move it out 26 months to live within the budget profiles. And that caused the development costs to stretch out with it. We did take money out of reserves. About half of our savings were out of reserves, and the other half is out of operations through the year 1999.

CUTTING RESERVES

Mr. STOKES. So that brings us to the question of how can this work? How can you cut the reserves by more than 50 percent and still make the program work?

Mr. KOHRS. The reserves, at the time of restructure were—as it is shown on the chart—about \$8.3 billion through 1999. When we came out of restructuring, we had reduced that to about half, to \$4.1 billion. That represented over 20 percent reserves remaining to go in the program and, at that time, we thought that was adequate.

Mr. STOKES. Now, earlier on, as we recall, Mr. Goldin's statement referenced the reserve money being much further out rather than earlier on; Is that correct?

Mr. GOLDIN. I was referring not to the condition in 1992 but, right now, today. If you take a look at our fiscal year 1994 submission, or, actually, even in fiscal year 1993, the reserves were in 1995, 1996 and 1997, if I remember correctly.

Mr. KOHRS. In the next three years, 1993, 1994, 1995, the total adds up to about \$350 million reserves. Starting in 1996, as Mr. Goldin said, we approached \$500 million or \$600 million a year that we built in the reserves. The aggregate is over \$2 billion, but the majority of that is 1996 and subsequent. Percentage-wise, the reserves in the budget for the baseline today are about 19 percent through fiscal 1999.

Mr. STOKES. I think that is what we are talking about now, how can you make the program work now with the reserves not being present?

Mr. KOHRS. Well, coming out of restructure, we had roughly \$4.1 billion in reserves. We had a number of major changes we did not incorporate during restructure. We had something we called "systems verification" which is how you assure yourself that the 17 flights it takes to build a space station are all going to play together after we have launched them over three years.

As part of the restructure report to Congress, we pointed out that we had to deal with this major systems verification from the time of the restructure report which was, I think, in March of 1991 to June of 1992. We worked intensively on how to solve this verification. We spent about a billion dollars of this \$4.1 billion reserve during that year.

At that time, we felt we had accounted for all of the near-term changes in 1991-1992, 1993 and 1994. We were doing fine until we got into this December-January timeframe where we have got some additional cost growth that went in and took more of our re-

serves to the point that we didn't have enough reserves to cover 1993 and 1994. That created this intensive relook at how we would reshape the program to live within our budget.

So, from a program standpoint, having dealt with all of the program changes that we knew about, going into 1992 with \$100 million, and having \$350 million over three years, we thought that was adequate knowing we had ample reserves out in the 1996 through 2000 timeframe.

In hindsight, again, we got some input data that said we didn't totally understand where we were in the program. Now we are re-looking at how we can get ourselves back within the overall budget profile. As you get closer and closer to critical design review, and closer and closer to flying and building hardware, the tougher it is to go find things that you can take out of the program. It is just hard to do.

COST GROWTH

Mr. STOKES. Let me ask you this, Is the primary reason for the increase in total cost between the 1993 budget and the 1994 submission—from \$29.6 billion to \$31.3 billion—driven by the surprise that you just referenced in the McDonnell Douglas work package to the space station or by delay?

Mr. KOHRS. No, sir. It is primarily by the delay. From the 1993 budget to the 1994 submission, we had a budget mark from the Congress that marked us in FY 1993, from \$2.5 billion to \$2.1 billion. And, as part of the blue team activity to try to get some costs out early in the program, we took a reduction within NASA of 1994 and 1995; over the three years, we took a cut that amounted to \$700 million.

That \$700 million cut was because of a four-month slip to first launch, a six-month slip to the launch which is man-tended, and a nine-month slip to permanently manned capability. That moved us into a permanently manned date from September of 1999 to June of 2000. That nine months of pushing this program out to PMC is what is the difference between the \$29.6 and the \$31.3 to achieve permanently manned capability.

Mr. STOKES. So what you are telling us is that the surprise is not figured in.

Mr. KOHRS. I don't like to call it a surprise. It is a bigger cost growth than we anticipated. We think, given time, we can work most of that down, and we still have a number of weeks, or maybe a month, to work that off. Now, this will get factored into this other activity, which is a redesign activity. But the program on the baseline is still working to get this cost growth down to live within our 1994 OMB budget that we submitted or are submitting.

WORK PACKAGE II COST GROWTH

Mr. STOKES. Mr. Aldrich's testimony before the Science Committee on page three, there is a paragraph at the bottom which is somewhat troubling. What the paragraph seems to say is that, basically, you do not really understand how the recent cost growth occurred in the McDonnell Douglas work package two, that you are not certain how to prevent it from recurring, that everything

would have been okay if you could have slipped a major milestone an additional three to six months.

To someone reading this, that has a tone of, "we are not sure what is wrong, but we feel everything will be fine if we can just slip the programs some more".

I am not sure we would agree with that solution. I think there may be more work here than may be fixed with another slip. How would you comment on that?

Mr. ALDRICH. I would like to explain that and clarify why that was written at that point in time. There is one other sentence in here that is very pertinent. It says, "but until all our reviews are completed I cannot provide you with this assessment". When we wrote this, we were still heavily involved across the program to understand the projected billion dollar cost growth that was announced between December and January of this past holiday season. And these intensive reviews would have validated how much of that cost growth we actually would have to deal with, and how much we could find ways to work around. Mr. Goldin also asked that an independent review team be formed to look with us in parallel to be sure we understood the costs. At the time I wrote this paragraph, I said in that hearing I did not want to try to explain the real reasons for the cost growth in detail or the solutions because we were just beginning the independent review, and we were in the middle of the program review. So the intent of this was to refer to the timing of that report and not at all to say that we weren't going to get to the bottom of it and understand it and, in fact, find the ways to prevent it from recurring.

Perhaps I could add to that. We are still in that process. In fact, the program review is scheduled to be completed on March 31st, when we will have a real feeling of what the size of this projected billion dollar cost growth will be. And I think we will have found that we can substantially reduce it.

Secondly, the independent cost review will not be completed until April 15th, and we want to understand their findings as well before I summarize for this Committee and others the real nature of these details.

Mr. STOKES. Again, if I can, let me refer you back to your testimony where you state: "Our preliminary data indicates that we slipped a major milestone schedule last fall an additional three to six months. We very likely could have lived within the existing funding program".

Mr. ALDRICH. Yes. And may I explain that?

Last fall, when we received our space station budget, it was reduced by \$150 million for 1993. We assessed how we would deal with that reduction, and we, in fact, did implement the change that Mr. Kohrs described a minute ago. We slipped first element launch four months, and we slipped man-tended capability six months, and permanently manned capability nine months.

Now, seeing this additional need, we believe the billion dollar projected growth that we have been working on will actually affect us on the order of half a billion dollars rather than a full billion dollars. If we had taken the additional slip instead of slipping four months, six months and nine months, if we had added three to six months to each of those, we would have made available the flexibil-

ity in the 1993, 1994 and 1995 years to where we could have lived within those budgets.

We would have had the reserves to deal with this issue which was really based, to a large degree, on some optimism that we built in this restructure in our "blue-team/red-team" review and our response to the FY 1993 budget reduction. What I am saying is, the amount of flexibility in those three years and an extra slip would have allowed us to proceed to the period when the reserves were adequate to complete the program.

Mr. STOKES. So that it is clear, are you saying that if you are permitted to slip some more, this then affords you the opportunity to be able to get into some of the additional reserves which are further out?

Mr. ALDRICH. It would allow us flexibility to cover the current period. When we get further out, the reserves that we have described are there. I must also add, if we slip PMC further, there will be an increased cost between the time of today and the time we reach PMC as we described earlier. So it would allow a budget profile that we could meet our commitments. It would change aggregate costs to PMC. It would not change our requested funding levels in the years in the ensuing time frame.

SPACE STATION SUPPORT

Mr. STOKES. Let me ask you how you square what you are saying to us at this time with the statements made earlier today by Mr. Goldin when he indicated that when you delay a program it gets very expensive because you must continue to pay the same number of people longer. He used 300 people as an example, I believe.

Isn't that made by a factor of a hundred in a program like space station where you are talking about 15,000-20,000 people who are under contract?

Mr. ALDRICH. There is no question that that is exactly the point that Mr. Goldin made, and I agree with it.

On the other hand, Space Station, as we worked up until this point in time, is a 30-year operational program after the year 2000. And so, whether I arrive at PMC in the year 2000 or I arrive at it in the year 2001, the funding to support the Station and doing the science during that period is relatively unaffected by that.

WORK PACKAGES I, II, IV

Mr. STOKES. Let me have Mr. Kohrs run through in detail charts covering work packages I, II and IV. Those deal with the space station module, the space station trust, the space station power activities. I would like to have him tell us why so much work was added to negotiated contracts signed in September of 1988.

Why don't you run through the major items that were added to the original contract and explain to us why they were not in the negotiated agreement, Mr. Kohrs?

Mr. KOHRS. I think you are referring to this chart.

Mr. STOKES. The individual one.

Mr. KOHRS. Before I go into the individual charts, what I would like to do is address this chart just for a minute. This chart shows

that in a summary of all the proposals for work package I, McDonnell Douglas, GE and Rocketdyne—four work packages back in 1988. If I could just take a minute on this chart because this will get you back to the individual charts as we come to them. But it shows the proposal value that was submitted in 1988 for the four proposals.

Back then, we had a work package III with Goddard but that since got eliminated as part of restructure. And we had our supporting contracts for space station integration contracts, which is Grumman, the TMIS contract, which is Boeing, and the software support, SSE. And then we had a contract with the Martin Company for the robotic servicer back in the 1987 timeframe.

The next line is what we negotiated in September 1988 when we signed the contracts with these companies. Some of them were plus or minus a month around September 1988. We sent our first budget to OMB in September 1988. So the point made on this chart—if you look at the bottom, in 1988—we said we could build the Space Station we defined then for \$23.4 billion.

Since 1988, a lot of things have happened. We have been through some requirements changes that were NASA driven. We have been through some budget reductions, where we agreed to take out money in two different phases. We called the first one in 1989 a “rephased program,” and then a “restructure program,” that you refer to which we did in the 1990–1991 time frame.

If you look at the right-hand column on the bottom, even though it is a different Station, we have gone from \$23.4 billion in September 1988 to \$25 billion in the 1993 budget.

And, if you look at the 1994 budget, this \$25 billion number is \$24 billion because we reduced the costs in the 1994 budget. So, looking at the forest, realizing we made a lot of changes and we have had to do a lot of things, the station budget has grown 3 percent from 1988 to the 1994 budget. Now, it is a different Station.

Mr. STOKES. You are only talking about half of a station.

Mr. KOHRS. It is a different station, but had we not had cost reductions, had we not made requirement changes, we probably would have wound up with about the station we have today for this same \$25 billion through 1999. That is the only point I wanted to make on this chart. Now I will go into these more detailed charts. I will start with the chart that is labeled “Work Package One,” which is Marshall Space Flight Center, and Boeing is the prime contractor.

Before I go down this list, this contract had two bidders—the Boeing Company and the Martin Company. Both of their proposals were within \$30 to \$50 million.

The proposal activity started in early 1987. The proposals got locked up. They got sent out to the contractors and they bid on what the Government sent them. As the proposals were being worked, the Government was still working requirements changes on how they might modify the Station once the proposals were received. So we went about six months where the proposal activity was locked up within the contractors, and requirement changes were still getting worked.

Coming into 1988 is when we finally negotiated the contract. There was a \$1.6 billion negotiated price. Now, if you go back to

the page, and the reason why I showed you that page before is even though the proposal was \$957 million, we negotiated \$1.636 billion. NASA had an independent cost team at that time, and their estimated cost to complete for this space station work package in 1988 was \$2.6 billion.

We budgeted \$2.7 billion in the budget that we sent to OMB. The only point here again is we recognized here that the proposal had some weaknesses, if you will. Some of the weaknesses were caused by new requirements that NASA brought in. Some were caused by better understanding of what the contractor definition was. But the bottom line is we signed up to a negotiated proposal that was \$1.6 billion, but we put in our budget what we had estimated to be is \$2.6 billion. It was to the Government's advantage to negotiate a lower price because we pay the fee on the lower prices when it comes time to talk about award fees, but that is the history of how we got there on work package one.

Mr. STOKES. On that point, aren't you in effect saying that you signed a contract at a certain price, with the knowledge that it cannot be completed at that price, therefore you have to put in your budget the realistic price that you expect to pay for that contract?

Mr. KOHRS. That is what happens, and you will see in the—

Mr. STOKES. That is what you are going to change, Mr. Goldin?

Mr. GOLDIN. I want to try to come back and tie the reforms to the issues that we are seeing. There is a fundamental problem, and I was on the contractor side in a situation like this. The market force is driven. I don't want to say that the contractors are bad because we had two competent contractors bidding for the job, but when you have a process where you don't have a clear, thorough understanding of the requirements before the RFP gets released, you get into this difficult situation.

The second part of the problem, again, is a system that NASA has; I think that DOD does it differently. When the Department of Defense has a procurement, before the best and final offer, they send listings to the contractors as to what the design deficiencies are, and what clarifications they have to have to make sure that there is a thorough understanding of the requirements on both sides of the contract. Then after all the clarification occurs, they ask for a best and final offer. So you don't get yourself in a situation where after you pick a winner, you have to then go make a number of changes, because the contractors have an enormous effort in building the proposal. They know which direction they are going to go in and then you get some breakage.

The problem is further exacerbated by the fact when NASA has requirement changes they know are coming, the contractor is proceeding along with, if you will, a large number of people and then you put changes in and it disrupts the planning process. So I want to come back to say that in the context of the reforms we are talking about.

There are two basic issues. Issue number one is we should not release an RFP until there is a thorough understanding that the requirements are frozen, even at the expense that we start the program late. And we should not release the RFP until there is a thor-

ough understanding on both sides as to what the requirements are so that the contractor doesn't have to do a set of plans.

There are sometimes 40,000 to 50,000 pages in these proposals. There is a very, very thorough planning process. So if during negotiations you make a 50 percent or 100 percent change, it throws all that planning out. So while the program is starting out, replanning is going on and then you allow a possibility for error to enter in. So those are the issues and, again, I want to emphasize these are good people, these are good companies.

There are good intentions, but we have a fundamental flaw in the process that NASA got started on some 35 years ago and we haven't changed it and that was the point I tried to make up front.

Mr. STOKES. Would you say that Space Station is the worst case scenario of this?

Mr. GOLDIN. Gary, I don't know.

Mr. ALLISON. No, I don't think so. I am sure there is one worse somewhere. I can't name it, but I am pretty certain there must be.

Mr. KOHRS. We talked earlier this morning about the \$596 million which was expended in the definition phase. I would admit that one would think, if you spent that kind of money in the definition phase, you would have come out with a pretty good performance specification that you would have laid on your contractors.

As Mr. Goldin said, there was a lesson learned here. We did not have a good performance specification. We did have a lot of concepts about how to build a Space Station. We had gone through some of it since 1984. Some of this is from memory, not mine, but from what I read. From 1984 to 1988, we went through seven concept configurations and settled on RFPs in early 1987. But in my judgment in looking back, we did not produce what I would call a good design to specification that went with the RFP.

I think that is what reflected back in the lower numbers.

Mr. STOKES. Let me ask you this, if we had appropriated the money necessary to fund all the negotiated contracts plus a reasonable reserve, it would appear from these charts that neither NASA or the contractor could have flown the Space Station that you told us you would fly in 1987.

Mr. KOHRS. In my judgment, that is a true statement. I mean where I sit from my view, and when I look back, that is what I would say.

Mr. STOKES. Thank you. I will let you proceed.

WORK PACKAGES

Mr. KOHRS. Should I go on to the Boeing work package one? What happened was what I call three major revisions since the inception of the contract and they are listed there as \$224 million, \$794 million, and \$488 million. But initially even though we negotiated the contract, the program realized that we could not support a PMC date which was October of 1995.

So the schedule adjustment was made that was equivalent to \$224 million that slipped PMC 14 months. That is shown on this chart. Most of those dollars were moving the program 14 months schedule-wise to the right.

The \$794 million reflects an activity where the Congress, in July 1989, asked us to reduce the budget \$400 million in 1990 and \$600 million in 1991; we did an intense exercise, which started out to be one-month, largely hide-away, and which turned out to be a four- or five-month study. But we came back to the Congress and said "We couldn't do the \$400 and \$600 million reductions. We can do a \$300 and \$500 reduction; but what that did again is it slipped out the schedule."

We took out three major items during the rephased program. We took out the new suits which were in work package II. We took out the hydrogen propulsion system and went to hydrogen, which was work package II, and we changed the work package IV from an alternating current and a D.C. current power system to an all D.C. power system and took out that development money during that time frame.

That didn't get negotiated even though that happened in 1990. It got negotiated in the contract on January 1991.

The next major thing we did, with which I think Members of this committee are more familiar, is the restructure activity that we did from October 1990 through March 1991; that requirement was to take \$551 million out of fiscal year 1991 and \$606 billion in 1991 through 1996.

Always our goal was don't slip first element launch more than you have to, and don't slip the sixth flight, because our goal was to get a lab in orbit so we could start to utilize this laboratory on-orbit. Even though we held the eight-month slip to first element launch, it caused permanently manned to move 26 months. That saved money in the near years, but cost in the outyears, because the program was stretched out an extra 24 months.

Those things reflect back in here. It is true on top of all this, we had a Congressional direction thing to reduce money; but on top of this, we had our own set of requirement problems. Requirement changes included a major weight and power scrub that we did in 1990; and that factored into our restructure program.

We also, if you remember, in early 1990, had an immense activity called the Fisher-Price team where we had challenged the amount of extra-vehicular activity time we were doing. That team, which the program started, recommended that we do some drastic things to reduce EVA, which, coupled with restructure, saved us EVA time because we went to a pre-intergrated truss.

We went to more robotics to more maintenance with robotics. We went from four photovoltaic modules for power to three. We went from an eight-person crew down to four. That took money out of the budget in early years, but slips in the program add money in the out-years.

That is just a fact that we said here today on every one of these programs. You just have to get the thing done up front if you want to maximize the dollar savings, but that is the activity that is on this page and there is page and page of detail of what item was done here and what item was done there. But those are the major items that we did over the life of this work package.

WORK PACKAGE II

The next page is work package II, which is the Johnson Space Center and McDonnell Douglas. The proposed effort was \$1.7 billion.

As I said earlier, while that RFP activity was going on, there were further requirement definitions and you will see six or seven technical adjustments where the engineering team had made changes to the thermal system, to the communications and tracking, and to the test articles. So, by the time we got to the McDonnell Douglas bid and proposal, and got into the negotiation process, the Government negotiated in an additional \$830 million dollars. \$700 million of hardware in the top two items are people support, people support to Johnson Space Center and people support to our Reston facility.

That got you down to the \$2.6 billion and here again back on the first page, the NASA assessment that even though we had negotiated that price, we put in a budget of \$3.6 billion.

In the 1990 budget that we submitted to the OMB, we were anticipating additional requirement changes as well, but from a Government standpoint of how we budgeted, we did request the additional dollars.

Here again the same thing happened within the work package II. We went through the rephased program. We went through the restructured program. We took things out. We went to the pre-integrated truss.

The bottom line is that we spent more money because we stretched the program more than we had going into the program. The other thing that went on early in 1988 as part of this activity was that we systematically went through a phase A. We went through a phase B. We awarded a phase C-D contract, which meant proceed to development, proceed to build hardware, in NASA as well as a lot of DOD programs.

You go through a series of reviews. You go through a preliminary requirements review that goes back and looks at the requirements to make sure that everybody thinks we have the right set of the requirements. We did that in 1988 and there were some requirements changes that got back in. Had we had a better spec, some of those probably should have already been in that PRR. The primary requirements review generated a significant number of requirements changes that got factored in. And this number here that, the \$597 million, was a reflection of our requirements changes that got added into our program after that 1988 exercise. It didn't get negotiated until late 1990.

Mr. KOHRS. The other big items here are the restructure cost proposal, where we slipped, which I said earlier; on work package one it added \$658 million to this work package two contract.

On the bottom of the page, we are still in negotiation with McDonnell Douglas for a number of changes that NASA has approved; and as I mentioned earlier, the biggest one in there is the avionics hardware and software verification. Right or wrong, this program coming out of the 1988 did not have, in my judgment and that of a lot of our team, a good systems verification program.

How do you know that when you launch flight 17, it is going to work with flight number one, when number one is launched three years earlier? The program worked for a year-and-a-half to create a program-wide verification program. We didn't culminate that until June 1992, but for that change alone, which was significant, we took \$500 million out of our reserve. But we knew we were going to do that, and we pointed that out in the report that we sent to Congress in March 1991.

It indicated that we knew we were going to spend \$150 million a year on this systems verification, had Hubble telescope not happened; and people said we didn't do the right verification on that program. The people we had working on that program intended to have a good avionics hardware systems verification program, and we put in time and we consciously did it. It was not in the 1988 proposal.

Mr. STOKES. Can I interrupt you for a question on a point of clarification? Looking at that chart, using the figures at the top, the \$1.7 billion, and the difference between that and the \$5.2 at the bottom, and granted that you have told us some of that is obviously due to slippage—

Mr. KOHRS. Yes, sir.

Mr. STOKES. Obviously a great deal of that must have been due to lack of the specific requirements.

Mr. KOHRS. Just as an example, in the very middle of the page the \$597 million was all driven by additional requirements that came through our preliminary requirements review that we did in mid-1988. So the answer is, yes, we did have change in requirements as well as budget cuts.

Mr. STOKES. So then the question, what good was the \$596 million there in phase B?

Mr. KOHRS. As I said earlier, in my opinion, we did not do an adequate job. And a real lesson learned, that Mr. Goldin talked about, is we have got to have good RFPs with good performance specifications when we ask a contractor to bid; and maybe it is easier—maybe we should wait a year to write a good RFP and a good specification.

Mr. STOKES. When you know what the requirements are.

Mr. KOHRS. But there were a lot of things going on in the 1988 timeframe coming out of the Challenger accident, which influenced our efforts to get this program going. And there was a lot of internal activity that was encouraging us to get this program started.

Mr. ALDRICH. Could I add a perspective to this? This is only an opinion as an outside observer at the time, but maybe Dick would be able to comment also.

I believe in the time that we spent the \$596 million, one of the objectives of the Station was to broaden what it could do as a facility to meet as many potential users and user communities and station participants as possible. That was an ongoing process that was going on in parallel with preparations for the station.

So it was almost an intent not to have a single, fixed, pinned-down configuration at any point in there, because we were still seeking how to maximize what the station could be and what it could do, at the same time we are trying to get on with starting it.

That is a personal opinion about that period.

Mr. KOHRS. If it is okay, I will go on to the next page, which is work package IV.

WORK PACKAGE IV

Mr. STOKES. Please do.

Mr. KOHRS. Which is Rocketdyne, Lewis, and I know this first number is \$1.987 billion, but I have been on the phone this morning with my friends from Lewis and Rocketdyne, and they insist that their bid was the \$1.622 billion. I apologize, and we can correct this chart. What I found out is that initially the proposal came in at \$1.622 billion; Lewis wanted to increase it, because they thought that some additional scope needed to be added.

But the bottom line is that Lewis and Rocketdyne signed up for the initial proposal at a negotiated price for the same. You say, why did this happen and not happen on the other contracts? One reason I can offer, which may or may not be right, and other people can comment, is that we only had one bidder on this work package. If you look at where we are today, back to the early pages of this contract, it was \$1.622 billion in the proposal, and NASA submitted \$1.715 billion. And today, with all of these changes we have made, we are at about \$2.1 billion.

But you have to admit this power system is unique to the station in that it is not a distributed system. It is more a stand-alone system, if you will. Even though we send power to the truss and we send power down to the labs, the requirements to power the system were probably easier to develop than it was for the systems of avionics, environmental control, tracking.

But as you see on this chart, even though we went through these pluses and minuses, the percentage cost increase in this contract is lower than in the other two work packages. Here again, the same things happen.

These mods—the two big ones—the \$236 million reflects a re-phased program, and the \$557 million reflects the restructured program. Here again, we slipped out the PV production 24 months and it reduced the early money, but it stretched it out, and we just lowered demand. And what we really did in this program is coming out of restructuring. We really didn't reduce manpower; we just leveled off and let it spend out to live within our budget program, which is how we got to where we are today.

Mr. KOHRS. And I will be glad to provide the staff with more detail of what this is. But that is a broad overview.

COST INCREASES

Mr. STOKES. You can also see on all three of these charts that after restructuring in 1991, even though actual hardware content was taken out of the program in all three cases, costs still went up substantially.

Mr. KOHRS. Primarily due to delay.

Mr. STOKES. In work package II, there is a total of \$5.2 billion. Does that include any of the recent \$500 million?

Mr. KOHRS. No, sir. And that is what, as Mr. Aldrich said, we are still working off. The current number that goes with work package two is \$533 million, but as I said, we are still working that number

over the next couple of weeks and we feel we can bring it down some more.

How much of that is real due to NASA or due to contractors will be in negotiation.

Mr. STOKES. Let me ask you, would it be fair to say that the McDonnell-Douglas proposed bid of \$1.7 billion had absolutely no basis in reality?

Mr. KOHRS. No. I think as Mr. Goldin said, the people that work on these things are responding to Government requests for proposals, and I am sure that in the Source Board, which is our Source Evaluation Board, they were graded on the intent of the proposal. When we evaluate proposals, it is normally on four or five major factors.

Cost is one, management is one, key personnel is another, and technical assessment of the proposal is another. I was not at the Source Board, but my experience with source boards is that contractors who don't meet the intended request for proposals, are not thrown out, but they are sent back to rework it. In my experience, here again, I can't speak directly for this, but in talking to people who were involved, that is my sense of this. They were responsive.

Mr. STOKES. But aren't we again talking about a totally flawed RFP?

Mr. KOHRS. I wouldn't say flawed. I think that the RFP and the specification that we had at that time was probably not adequate in terms of its quality.

SPACE STATION RESTRUCTURING

Mr. STOKES. Isn't it also true that even though the program went through a major restructuring in 1990, the cost of the development piece of the program actually increased owing to the slippage and technical changes—but station capability in terms of available power, lab volume, rack space and so forth was significantly reduced?

Mr. KOHRS. That is right. As part of restructures, we reduced the size of the lab from 44 feet to 27 feet. In my judgment, had we not had restructured, the program would have reduced the size regardless, because we were approaching a weight limit with the shuttle performance. Our plan then was we would launch two labs, each 27 foot long, to replace the one 44 foot. But then came restructure and we said we couldn't afford to build the second lab and the second hab and the two nodes. We pushed that out beyond the year 2000 and did not budget for it. And in our report to Congress, we said, to complete that part of the Station and to get to an eight-person crew was equivalent to about another \$2 billion of recurring costs to build that additional hardware, another version of what we had already built, another lab, another hab and two more nodes, of which we already had two in the baseline.

But the answer is yes, we did reduce capability, and if you go back to 1988, the Space Station in 1988, had 75 kilowatts, had an eight-person crew, had a 44-foot lab and a 44-foot hab and four nodes. So the capability did come down.

Mr. STOKES. So from the outset of the program, we have consistently been paying more for less?

Mr. KOHRS. As we have lived within the budget constraints and lived within our requirements, we did lose capability. Some of our requirements drove us to make changes so we could live with the requirements we thought were more mandatory than others, as an example.

Mr. STOKES. Also, isn't it true that even if you were able to solve the most recent overrun in the McDonnell-Douglas work package, you would have to solve that problem in part by removing additional program consent?

Mr. KOHRS. We started off with a \$1 billion cost growth. We had \$461 million of reserve to use against that \$1 billion. We used \$111 of it, and then we made some hardware reductions. But primarily we did some consolidation of our facilities on the ground, our central avionics facility, the way we process hardware at the Cape and the contractor; and we proposed some reductions in our program management at Headquarters and at Reston, that got that \$1 billion number, after having spent \$111 in reserves, down to a \$503 million problem with \$350 million reserves.

If we spent the \$350 reserves, we would be working off a \$150 million problem. But we haven't brought that forward yet to the program to make that the new baseline. We are still working it and we still have a bunch of work to do.

Mr. STOKES. So if you did that, then you would not have any reserves?

Mr. KOHRS. That is right. At this point in time we don't want to do that. That is why we are still working on it.

MANAGEMENT STRUCTURE—RESTON

Mr. STOKES. Is part of the solution here to close Reston?

Mr. KOHRS. Oh, I can't really answer that. There are a number of management changes that are being looked at, and the new redesign team will also be looking at the management structure, so I really can't comment on that.

Mr. STOKES. Mr. Lewis.

SPACE STATION REDESIGN

Mr. LEWIS. Yes, thank you, Mr. Chairman. I have spoken more than once about the value of broadly-based and bipartisan support for center stage efforts in space, namely, a manned space station. It appears to me that things are happening out there within the mix that is the House and Senate that caused a good deal of concern. I want to know if you are both aware of that and what you may be doing about it.

I refer to an article I am sure that you are familiar with in which my colleague from California, George Brown, is quoted rather extensively. Some of those initial quotes, I gather, had to be cleaned up for print. Chairman Brown's comments essentially warn against the problems that may swirl around redesigns, indicating that NASA has spent some \$8 billion getting us where we are today. He is concerned about where redesign that is directed from downtown may take us.

At the very same time, I understand the gentleman from Texas, Senator Gramm, has raised similar concerns. It causes this

Member to hope that all of you are very sensitive to the ramifications of losing that bipartisan constituency and base.

So with that as background, I am interested in hearing from the Director or you, Mr. Kohrs. Are you under specific instructions from the White House regarding how to reconfigure the scientific missions of Station? To what extent have scientists from other Federal agencies like NSF, NIH, DARPA, already been involved in assessing or determining the space science applications of station?

Mr. GOLDIN. Let me address that question. It is a fair question. First let me say I have talked to Chairman Brown on the phone on Friday of last week, and I did receive his letter, and I will be responding to that letter. I think he has been a strong supporter of the space program.

Mr. LEWIS. He has.

Mr. GOLDIN. I believe he has been a strong supporter of the Space Station, and I believe that the letter that he sent to me deserves a very thoughtful answer and I am willing to take the time to give him a very thoughtful answer to that letter.

I also want to say that I personally did meet with Senator Gramm to discuss the issue with him, and I did read what he wrote in the paper. That is by way of background. By way of direction, we have a set of requirements, not configurations, that have been specified to us in terms of the groundrules for the redesign. We are in the process of interpreting those requirements and trying to reduce them to configurations. One of the groundrules we have is that to the maximum extent possible, we must utilize the work that has been done to date. There were initially three start points for configuration, but I believe by the time we go through a process, there will be as many as six to eight preliminary configurations which will be narrowed down to about three.

I know that this week the contractors are coming in, meeting with the team, making their suggestions. Our international partners—as soon as we work out a process with them, and their comments are due today—have indicated that once we work out a process agreement, they may want to make a recommendation. We said we would be pleased to accept such a configuration. Then after we get these whole series of configurations, we hope to narrow them down to three, a low, medium and narrow-high configuration. I don't know what they are going to be.

The other thing I do want to say is, I still am guesstimating at what the dollar value is. But at this point in time, we don't have a firm number on the dollar value from OMB, but we should be receiving it this week. I have been told that we will, and hopefully, we will. That is going to be the determining factor for us. The higher the number, the closer we can approach the configuration we have.

But that is the guidance we are operating under, and believe me, my level of discomfort goes up very, very high when I see strong supporters on both sides of the aisle with the discomfort that they have. It does not give me a good feeling. On the other hand, I believe, as the Administrator of NASA, that I have an obligation to carry out the policy of the President. And I have to carry out that policy, while at the same time being as sensitive as I possibly can to the Members of Congress.

So we are going to try to come up with something that comes as close to satisfying the needs of all, but right now, we are on the path I outlined.

CONSOLIDATION IMPACT

Mr. LEWIS. I have just been informed that apparently the gentleman from Virginia is expressing some reservations as well. When you see those kinds of multiples on both sides of the aisle, the initial support base, it means that there is homework that definitely needs to be done.

You indicated that you can't really tell yet on a preliminary basis what the numbers look like. In terms of reduced personnel, it would appear as though there could be some impact upon McDonnell-Douglas' location in Huntington Beach, California, Clear Lake, Texas, and I guess Florida as well; is that right?

Mr. GOLDIN. The answer is, we don't know until we know the configurations. I will tell you the approach that we are operating under. The approach that we are operating under is to try to the maximum extent possible to balance out the labor force by doing the right thing. In order to do that, within the President's budget for NASA there is also a technical package that will kick in as the staff comes down on the space station to some new level.

We are going to try and place those technical packages in the areas that would have an impact. So, overall, the labor force would be relatively constant in those areas. That is another overlay that we are working on, trying to provide some balance in the labor force.

NATIONAL AERO-SPACE PLANE

Mr. LEWIS. Tell me what I don't know about what this redesign may be doing in terms of your new commitment to aeronautics, what impact that might have upon the use of station.

Mr. GOLDIN. I am sorry, I don't understand the question.

Mr. LEWIS. It is my understanding that current support within NASA as it relates to National Aero-Space Plane (NASP) may very well cause some budget adjustments that could absorb dollars that otherwise might have gone for station.

Mr. GOLDIN. Let me talk about the NASP program, and say that, for about the past six months DOD and NASA have been working on the NASP program. We took a look at the program about six months ago and then the Defense Science Board did a study to say that they were concerned that we were not ready to proceed with the X30. NASA concurred in that recommendation to the Defense Science Board.

The Defense Science Board furthermore recommended that before we were to proceed forward with even a prototype or experimental plan, there were some fundamental physics problems that had to be resolved, and they recommended a much more reduced program that would get at the basic issues on NASP. One is an issue called Boundary Layer Transition, which says normally, the air will flow smoothly over a wing and that is called laminer flow and then when it starts breaking up it becomes turbulence.

One of the key problems with NASP is, which is a machine that goes with the Mach 25, if I have the boundary layer transition on the front part of the inlet of the aircraft, I have a tremendous heating effect. If it is on the back end, there is a much smaller heating effect.

So the Defense Science Board recommended and NASA concurred, to do a series of very low-cost small tests using a Minuteman launcher, if you will, and then put some models on top and measure its boundary layer transitions, for a small amount of money, rather than waiting to spend some billions of dollars to build the plane to figure it out.

The second thing they recommended is that we did not have the test data necessary to validate that we understood how to build a SCRAMJET, which is a critical engine for the NASP. Again, they recommended a very low-cost flight test series. So what NASA had done well before the decision point on the NASP was work with the DOD to an equation whereby NASA puts in varying dollars, and DOD puts in X dollars. We laid that into our budget and it was part of our budget submittal.

Mr. LEWIS. Mr. Chairman, I take it we are off the course. I didn't really mean to do that, but I would hope that we would revisit this whole subject area.

Mr. GOLDIN. I just wanted to say that I don't believe it is coupled, but that is what we did. We worked with the DOD, and in fact we have a series of meetings set up with the DOD to talk about that program.

Mr. LEWIS. Okay.

Mr. STOKES. Mr. Mollohan?

CRITICAL DESIGN REVIEW

Mr. MOLLOHAN. Thank you, Mr. Chairman. What is the status of Space Station Freedom? Is it final design review?

Mr. KOHRS. We are in——

Mr. MOLLOHAN. Critical design?

Mr. KOHRS. We are in what we call the critical design review which is for the first six flights, which takes us through the mandated capability. Critical design review by definition normally means that you have released, for those six flights, 90 percent of your central drawings. And as you go through that review process we do a work package review at Rocketdyne, which we completed last week; we are now doing one at Boeing in Huntsville, which will be completed by the end of this month; and we complete the one with McDonnell-Douglas and Johnson Work Package II at the end of April, for the subsystem hardware. Coming out of that, we give the contractor approval to proceed with the manufacturing hardware.

Mr. MOLLOHAN. So that is the step immediately preceding building flight hardware; Is that correct?

Mr. KOHRS. Yes, sir. Normally that is it. And then to culminate all that, we put that all together into what we call a systems level critical design review that we do with our Level II office on the whole program, including our international partners and including

the users. And we are scheduled to do that in the June timeframe of this year.

So coming out of June on the baseline program, we will say we are ready to proceed with the critical design review that takes us through flight 6. In the meantime, we are then gearing up to do the critical design review for flight 7 through 12, which will be done roughly a year from now. So you build through an incremental design review process with both the contractor and the Government.

Mr. MOLLOHAN. Setting aside for just a moment all of the reasons for cost problems associated with the program—how in the world could you save any money, no matter what the configuration you come up with, by going from this stage, which sounds like a pretty advanced stage to me, back to almost ground zero? And to reassess the project, particularly in light of your new way of approaching programs with thorough design reviews and studies to make sure that you know everything that has to be in the program?

It is difficult for me to understand how you could save money at this point, no matter what problems you have had to date and no matter how many cost overruns! How can you redesign it again? Before I get an answer, let me ask another question. At what stage were you before the Congress instructed the redesign, in 1990 or 1989?

Mr. KOHRS. We were then what we called the preliminary design review. As I said earlier, in our process you do a preliminary requirements review earlier, approximately the first year after the contract. After that you do a preliminary design review.

At the time of restructure we had just started the board for the preliminary design review and we knew we were going to restructure. We made the conscious decision to complete the PDR on the old baseline so we would have a good base. We are working today on the critical design review, and we are going to complete this critical design review so that we again have a good base for whatever the redesign may be. Because, as Mr. Goldin says, one of the goals of the redesign is to use as much of our existing subsystem hardware that we are developing, and going through these systems' CDRs at the work packages will give us a good database to work on.

Mr. MOLLOHAN. If I may ask the Administrator that question. How can you effect an ultimate savings in this program by going back and starting over?

Mr. GOLDIN. We are going to do what we can between now and June 1st. June 1st is an absolute deadline that we have of providing our input. Let me at least describe the process we are going through.

Mr. MOLLOHAN. May I just ask you first, so you are reaffirming that June 1 is an absolute deadline? I appreciate the political policy part of this. But how do you reconcile this pressure to move quickly on a new design and a new space station with your previous testimony here today and your public statements about how NASA is going to be very careful and make sure we explore programs in detail before moving forward?

Mr. GOLDIN. Well, what I will tell you is we are going to go through and do the very best job we can on June 1st. And on June 1st we will establish what configurations we can come up with, what we see around the cost, what tasks have to be done to validate those costs, what we recommend as a program to make sure we don't have any bumps in the road. We are going to provide an input that is as a straightforward, open assessment, and we are not going to sign up to something that we can't—

Mr. MOLLOHAN. Okay. Tell me how I am wrong. Is this not repeating history? We are going to take this order and march with it, and we are going to do the best job we can in the time frame we have, irrespective of all my commitments to be very careful about the issues discussed today, making sure we have all the T's crossed and have anticipated all the problems this time around

Mr. GOLDIN. When we come to June, if they don't think we have a thorough answer to the question, we will say what we have. If we believe we need—we have the input to make—we are being driven by a date which says we have to make a submittal to the Congress by I think it is June 15th. That is I believe the date that is driving this.

Mr. MOLLOHAN. You are being driven by the June 1 deadline in the context of your commitment to make sure that you have—it right this time. So is it possible that on June the 1st you will say, Mr. President, we can't do a space station for any less money?

Mr. GOLDIN. I don't want to prejudge the results.

Mr. MOLLOHAN. Is it possible that that is an answer?

Mr. GOLDIN. I would like not to prejudge the result.

SPACE STATION RESERVES

Mr. MOLLOHAN. Okay. There is just so much to go into. Let me just start by asking Mr. Kohrs, were there no early warning signs in the system or early warning signals that came in December or January leading you to believe that you were going to have to invade reserves, or maybe exceed reserves?

Mr. KOHRS. The warning signals that we had which we expected came in early December. We expected to see some impact on to our reserves coming out of this budget reduction, and then our subsequent reduction that we took in 1994 and 1995, which was the \$700 million. We sent that data out to our projects in October, and they formally came back and replied to us in late November.

We saw over these three years about half of that figure in that timeframe, and we set off to work that. Then in January, we got the additional increase from work package 2; here again, from our process standpoint and metrics standpoint, we should have known about it probably in advance of that. But that is the way it turned out. We knew about half of it, and it was across all the work packages in our initial December input to us.

PROGRAM OPERATING PLAN

Mr. MOLLOHAN. What is the process by which you came to this? How did you come to it?

Mr. KOHRS. Well, the normal process was we put out a program operating plan, which is called a POP. Coming out of the FY 1993

budget mark, we put out a program operating plan to all of our projects, and asked them to give us their impact for this 4-6-9 slip. So that was the normal process. We got that back within a couple of months; it identified about \$480 million against our \$461 million reserve. When you sit back and look, that is a workable problem; so we decided to go off and work it.

Work package two, which was doing a more detailed assessment of their primes and subs in late December, decided that it needed to come forward and tell us that they had a bigger impact with the subs, and that is when we got into our intensive review, starting about the 12th of January.

Mr. MOLLOHAN. And that was in response to your request about the impact of a stretch-out in the program?

Mr. KOHRS. Yes, sir. As part of the process coming out of the summer, we received our mark from the Congress, the Conference Committee, that said, instead of getting \$2.250 billion in 1993, it was going to be \$2.1 billion. We, on the NASA side, said that we also were not going to increase the budget more than 10 percent a year in FY 1994 and FY 1995.

Even though the reduction was \$150 in FY 1993, the effect over three years was \$700. Our preliminary assessment was to keep this hardware, don't change the hardware. We absorbed it in a schedule slip that was equal to four months, six months to flight 6 and nine months to flight 17, sent it out to the projects and gave them a couple of months to review that, and that is when we got the initial feedback. That is our normal process, if you will.

Mr. MOLLOHAN. I may be misunderstanding this, but would you not have had this problem if there had not been the slip of the program?

Mr. KOHRS. If we had received the \$2.250 billion in 1993, and if we had not cut our FY 1994 and FY 1995 budget, we would be dealing with a lot less of a problem.

Mr. MOLLOHAN. As I sit here and listen, I grow to believe that regardless of whether or not the management processes were perfect, and even if you had had the reforms that you are talking about putting in place, it would still be awfully hard to manage this rolling program. I mean not only does it change from your standpoint, but it has also changed from the political standpoint.

Could you in the broadest terms give us some idea of what is driving these costs? To what extent is it political policy indecision, or to what extent is it underestimating requirements, to what extent is it program management problems? Can you give us some assessment of that.

Mr. ALDRICH. I would like to add to the answer that Mr. Kohrs gave you a minute ago. That answer implies that only the reduction in the 1993 budget and our choice to also reduce 1994 and 1995 budgets contributed to this extra cost. That timing contributed to when we get the submittal from the contractors that we asked for. That is why we found out in December.

But I believe there are inefficiencies or overoptimism in our program that really created some of the cost growth that we have been dealing with. We talked about the restructured program that was approved early in 1991, and our plan to implement that with our contractors. In fact, Mr. Kohrs described some of the timing of

implementing that, and also, some of the changes that we knew we had before us.

Two of the big changes in the restructure had to do with the hardware/software avionics system, altering that to meet the new requirements of restructure, and secondly, the ground-based verification program, primarily for hardware/software avionics. Those were two big challenges; they were part of the restructure. I believe the program, both on the NASA side and on the contractors' side, took an extensively long period of time to round out the details of those changes, work them into the program, direct the contractors and then have the contractors provide the feedback.

In fact, it was only in this fall time frame of last year, we were just talking about, that the effects of the restructuring those areas were appearing in the contractor and subcontractor costs. They were complicated changes, they were bigger than anticipated. I think had we defined those sooner, known about them sooner, we would have had a better shot at controlling them and not had some of this growth that appeared at this time frame.

Mr. MOLLOHAN. It was just a bigger factor than you anticipated?

Mr. ALDRICH. It was a bigger factor than we anticipated, and I think we took too long to get the definition complete and get it implemented in the system so we could cost it. If we had done it sooner, we would have had more time to react and we could have ameliorated some of this.

RESTRUCTURED GROUND RULES

Mr. MOLLOHAN. Were those changes initiated by NASA, or were they initiated by congressional redesign directives, or by what?

Mr. ALDRICH. Well, the restructured ground rules were worked between NASA and Congress. But, given those groundrules, and the system changes to make an appropriate Space Station, then the cost and scheduling was by NASA.

Mr. MOLLOHAN. Okay. Go ahead.

Mr. ALDRICH. I was going to also say that a large amount of this cost growth was with work package II, McDonnell-Douglas. We found in our review that some of our efficiencies and some of the production rates that they had projected to be able to produce drawings for these design reviews, and the software for the software drops, had not been as effective as they hoped, and so they had cost overruns in several areas.

We also found that some of the knowledge and some of the control of the subcontract costs were not as precise and not as technically controlled as we would like. We are working each of those areas. They are factors that again led to cost growth. They don't relate to schedule change particularly, they relate to a combination of inefficiency and perhaps inability to perform as well as we had hoped, both the government and the contractor would have performed in the areas that I have described.

PERFORMANCE PROBLEMS

Mr. MOLLOHAN. So there are some performance problems associated with work package II?

Mr. ALDRICH. We believe so. In selected areas, not across-the-board. We found in the software we were not able to build in the rates that we had hoped to build at. We have had trouble producing the drawings at the rate that our system required without bringing extra people on, which is extra cost. In the subcontract area, we are still trying to find out exactly the nature of the issues there and how to control it more tightly and not be surprised.

Mr. MOLLOHAN. How long a lag is there between the time of a problem like this is developing and the time it comes to your attention, or the most immediate program manager is attention? It seems like it is a pretty remote process, as I hear you describe it.

Mr. ALDRICH. Well, let me take the avionics changes we just talked about, for example. They were clearly required by the time the restructure agreement was reached in March 1991. They took program-wide large teams to resolve. I came on the program after that time, but in early 1992, I became aware that the issue with the avionics was large, and wasn't coming together.

I conducted some specific reviews personally with the contractors involved and with the NASA centers involved to try to be sure we were converging the avionics, so I knew then there was a problem. I didn't relate it to a cost problem particularly, although perhaps I should have. I think that led to the team coming together during the spring and early summer of 1992 and reaching the agreed necessary technical requirements for verification and for hardware and software configuration.

But then those things have to be directed to the contractor, they have to be trickled down to the subs, who have to price these things and bring them back up. And so the changes we knew we were going to make in early 1991 weren't fully defined technically until mid-1992, and therefore weren't priced until the end of 1992.

Mr. MOLLOHAN. You know something is coming.

Mr. ALDRICH. Performance, whatever, we had a bigger package of work, and it took longer to get it on the table and deal with. In fact, Dick has talked several times about getting this number back down to a manageable level. What we are working on today is trying to find the inefficiencies, and we have gone through that process and minimized the impact.

SPACE STATION MANAGEMENT STRUCTURE

Mr. MOLLOHAN. Thank you, Mr. Chairman.

Mr. STOKES. Mr. DeLay, I recognize you.

Mr. DELAY. Actually, Mr. Mollohan asked some very good questions; most of them are ones I wanted to ask. But let me just follow on to what Alan was talking about. I have here the current space station distributed management structure. My question is, how much of this kind of management structure had to do with the cost overruns?

As I look at this, I don't know how you get anything done on the Space Station. It seems to me that in my business, of course my business is not as big as NASA, but I have clear lines of authority. When you have this organizational chart it has an AA for Code D, according to this, or space development, I guess it is.

Is that you, Mr. Aldrich?

Mr. ALDRICH. That is me.

Mr. DELAY. Under you is the program director, under him is the program manager, and then you sort of bypass the center director and go straight to the work package manager, yet you really don't have any leverage, real leverage, over the work package manager, do you? Because the work package manager reports directly to the center director.

Mr. ALDRICH. I would like to make a statement first and then get to your specific question. The management structure you are discussing was intentionally created in this program in two time periods. The distributive work across so many Centers and so many work packages was an intentional goal in how the space station was put together in the mid-1980s to broadly distribute the work across the NASA team and NASA organizations, and then the contracting organizations they would go with.

The rationale for that, whether that would suit today's NASA plan for management or not, is something that ought to be debated and be debated a great deal, but nevertheless, that is the way it is. The second part involving an Associate Administrator, a Director, and then a Program Manager, is an organizational structure that was put together after the Challenger accident, and it was determined that at that time, through several independent reviews, that there should be a central management office in the Washington, D.C. area to have overall control of the program.

So those two characteristics of management came together in different time periods, but made what you have stated and which I agree with is a very diverse complicated management structure. It is not a management structure that NASA is happy with. In fact, over a year ago, NASA took action to review the space station management arrangements and discuss and recommend improvements. When Mr. Goldin came on board, he was even more concerned, looking at what you are looking at, and he asked that that study be intensified and added yet another team of people to look at it from an independent point of view.

We studied those internally, and, in fact, we recommended some changes in the fall 1992 timeframe that I am a supporter of. It was the NASA decision at that time to propose proceeding with changes that would have treated a number of the issues that caused inefficiency in that structure.

Unfortunately, with the transition to the new Administration, and now with the discussion of perhaps a different structure for Space Station altogether, this has gone on hold. I still think they are good ideas; perhaps there will be better ones as we go through the next time period up until June.

Mr. DELAY. And I understand, Mr. Goldin, I don't mean to cut you off Mr. Aldrich. Did you want—

Mr. ALDRICH. I was just going to get to your specific question next.

Mr. DELAY. Okay. I will get back to Mr. Goldin. I would rather hear your specific answer.

Mr. ALDRICH. The specific answer is the project managers at the centers do work for, report to and are responsive to the program manager for the program they work on, and there is a very tight

process of day-to-day, hour-to-hour interface, tight documentation, rigorous control that is used.

They do report as an employee to their center director, and that has been a process that NASA has used to manage programs ever since the beginning of the space flight time period. And the reason the work package is at a center is that it draws on the abilities of that center. It doesn't just have the project office that manages the contractor in another location; it also utilizes the engineering, the contract management, the organizations at that center to round up their job.

And so it is the responsibility of the center director, not only to oversee the project work going on at the center, but to be sure that project manager has that support, that engineering supports him, science supports him, program control people support him. In station, that is probably the largest, most cumbersome way of doing work that way, but yet it is based on a traditional mechanism and one that we have used for many years and have been effective in other programs.

REDESIGN OF THE MANAGEMENT STRUCTURE

Mr. DELAY. Mr. Goldin, I know the answer to this, but I want to get it on the record. Is part of your redesign of the space station Freedom going to be a redesign of the management structure?

Mr. GOLDIN. Absolutely. I would like to talk a little bit on the subject, and respectfully disagree with Arnie, and say that I have 20-30 years in the industry. I have managed, personally, multi-billion dollar programs, very complex programs; and never in my life have I ever seen the management structure like the one you have over there.

I am very, very concerned about that management structure. Now, there is a coalition that got together to put together that management structure, but I don't know how these good people here in this room go on the way they are going on with the management structure like we have here.

As much as I would like to say, clean lines of authority, and this man, and that man are in charge, they are not in charge. I am frustrated that it takes nine months to a year to get the data. And if you want to ask, my biggest nightmare is the data we are getting now is a long way off from where we are in time. That is not based on any data. It is just based upon a management sense that I have.

I am terribly, terribly concerned about the passion and the emotion that each of the physical locations on the space station have in terms of maintaining—I call it "baseball caps." You know, there is a Johnson cap and there is a Huntsville cap and a Reston cap; you name it. It is not like a fine symphony orchestra with one conductor that sits there and leads that orchestra.

The other part of the problem that exacerbates it is it is not as though each place is doing one clean piece of the job. On Apollo, NASA built the launch vehicles; Houston built the Apollo capsule. I cannot begin to tell you the management interfaces, the lists of hardware, the interchange of pieces of hardware that go on, the multiple test sites that we have.

In Huntington Beach, they go build a set of hardware which gets shipped to Clearlake, which gets tested in Clearlake, which gets shipped to NASA Kennedy, which gets tested at NASA Kennedy. There are separate crews for each place.

Now, think about the human communication problem, the training problem, the equipment, the logistics. We have meetings with large numbers of people. We have support contractors that help the NASA people do all of these things.

Now, we have got to deconvolve this system into something that makes sense management-wise, and a lot of people are going to be very unhappy. But either we are going to have a space station and have a clean management structure and say to this man over here, you are in charge, you are God, you go make a decision, and you don't have to have a board of directors meeting, you don't have to say to each center director, may I do this, or we cannot succeed. You don't have to have 50 people in the room to make a decision. You don't have to have coordination meetings. You hit a basic issue, and it must be deconvolved. That is the single most important thing that we can do.

And, again, I want to say, there is going to be some dissatisfaction when we get done because we can't make everybody happy. I view my job, as the Administrator of NASA, to look at the taxpayers as our customer; and we have a fiduciary responsibility to the taxpayers and not to the corporations involved in this and not to constituencies, to get this thing done.

And, again, I want to come back and say, there are very, very good people working on it. And these people have to go home with pain in their hearts. They work very, very hard. Yet somehow they are not getting there. And it is not their fault. It is our fault. And we've got to deconvolve the system. And it is going to be stressful, and we are going to take incoming missiles and everyone is going to be unhappy. But we have got to deconvolve the system.

As part of that deconvolving, we have to look at options. One of the things I want to assure you, one thing that is highest on the list that flashes in neon lights is, how can we deconvolve the system and get a sensible set of hardware?

NASA Houston is involved in the habitation modules, but they are being built in NASA Huntsville. Distributed systems get sent out all over the place. I went to one of the contractors, and I about fell on the floor when they told me they had 580 distributed computers. I absolutely, positively could not believe it. I almost went into cardiac arrest.

Let me be a little dramatic. I built systems before that are not as big as the station. But I personally have built huge systems which took five years from the day we started until the time we launched. So it can be done. If we are going to go do this, and everyone wants something out of it, everyone is going to have to have some sense and say, let us go do our thing and come back and tell you what we are doing; we will do it in as focused and as orderly a manner as possible; and we are going to do it right. Sometimes it doesn't have to take a long time.

I just want to come back and address the subject you brought up with me. I spoke to Joe Shea. I very maliciously and intentionally selected Joe Shea for a reason, because he had been through

Apollo. He didn't have 1,500 people doing his design integration. He had a much smaller number of people. Part of the problem of these multiple redistributions is everyone votes. Let me tell you how they vote. They come to the Congress and vote. They come, talk about me, and vote. They go talk about each other and vote. They lob shells at each other. Everyone has an objective—"I've got to protect my part of the program."

The real objective is that the United States of America has to build a space station and launch it and get it up in time and not preserve a contract at this contractor or that contractor and not preserve the jobs there. We have got to do it.

And so long as we have these complex, deconvolved things, we are never going to get there. And all we are asking for—and we are only human—is the freedom to openly go take a look at this. Again, this will be a little controversial. I think the President has given us a courageous task. It is the most difficult task I have ever seen in my career. But all we want to do is go off and take a look at it and openly communicate with the Congress.

Mr. LEWIS. If the gentleman would yield for the moment?

Mr. GOLDIN. I got a little passionate, and I back off. And I am sorry about that.

BLUE RIBBON PANEL

Mr. LEWIS. It is probably a good way to round off this piece of our discussion today. But there is a similar process, as I understand it, going on downtown, another blue ribbon panel that is looking at reorganization or how NASA should be reorganized.

Are they coordinating with you? Is there discussion taking place?

Mr. GOLDIN. Well, I will tell you what I know.

Mr. LEWIS. That is more than I know.

Mr. GOLDIN. In fact, I called my office today to see if we had an approved list of members of the Blue Ribbon Panel. I hope when I go back to my office today we will see a list of names, the Chairman and other people on it. The purpose of this Blue Ribbon Panel is to have—and I think it was you that asked the question: Do we have outside scientists involved?

Mr. LEWIS. Yes.

Mr. GOLDIN. It is the purpose of this panel to have people who have no financial connection to NASA, in a major sense, to objectively look at this. It also is the objective to have these people not wait until the end of the process but meet once a month, and I think we have picked dates like March 29th. So we had two weeks to get ready for the first meeting. I think that is terrific because we will get immediate feedback.

The object of that is to say hey, look, I think you are on the right path or the wrong path, rather than sitting back and waiting until the last day and say, boy, this thing looks like it is not going in the right direction. So we set that up, again, as part of the team building. So these people, hopefully, will be announced today or tomorrow. We will get them in on the 29th, and we will sit down with the team and walk through it.

We have asked our international partners to integrate right into the redesign team. We have defined 10 slots for them. They are

about 25 percent of the job. They will be about 25 percent of the number of people and work with us. Every two weeks, we plan on meeting with the key Congressional staff. And then I personally will meet with the rest of Congress that are key players in this.

Again, communication is very, very important. We are trying to listen to suggestions made. And I know Mr. Lewis made a suggestion about the reserves. He suggested that we get some independent assessment of reserves. We are setting up such a team to do that.

Congressman Brown has made a suggestion relative to a configuration we ought to look at. We are taking that very seriously. We are not ignoring that. But we would like to view this process somehow as we could do it as a team.

But if you want to know the biggest stress point we have, it is the issue that you brought up there. I mean that is a very difficult job, and maybe there will be a lot of salvation if we could solve that.

Mr. DELAY. Can you translate your description of this into money? I mean has it had a direct effect? You may have already—Mr. Aldrich may have already answered this—a direct effect not only in the cost overruns, but it could, maybe, save us enough money to appease the administration and continue on with the present design.

We could just change the management structure.

Mr. GOLDIN. I don't want to speculate on outcomes except to say that we are going to look at all possibilities.

But, again, I want to come back to a point that Mr. Mollohan was talking to me about. It is very, very difficult when you have thousands of people involved in a decision process to get clean decisions. And I will accept full responsibility. I am the one who said no more than 30 or 35 people working on this; and I think we are going to end up with 40 at our facility right here in Crystal City. And I said don't build a whole bunch of designs. If you need help from the Centers, go get the Centers.

But I believe that we could get a much more streamlined process to go do this. Will it meet all the objectives I had in my reforms? I think we have a shot. But I don't want to just commit to that. But we are going to try and go at this in a different way. We have not done it this way at NASA. Everything has been large committee votes. Brian O'Connor is in charge of the day-to-day activities. He is the smartest, toughest manager that I believe applies to this job. He is not out of the old mold; he is out of the new mold. He is an astronaut, U.S. Marine. I think he has the background. He was out at Patuxent. He has management experience.

No, he never managed any other specific activity; but, yes, he is the Deputy Director of the Office of Space Flight. And Jeremiah Pearson was kind enough to make him available to us.

But what he brings with him is an integrated experience with the shuttle. And the shuttle is the key tool to the space station. So all I can say is we are going to go at this thing very systematically, very thoroughly. We just started this process on March 10th, so today is the first week that we have been into this. And we have been staffing up during this week.

RECONFIGURATIONS

Mr. DELAY. I don't want to cut you off, but I don't want to use much more of the Chairman's time.

I just want to ask, the President has given you a directive of coming up with three or four options; is that correct?

Mr. GOLDIN. Well, the desire was to get options. We picked the number of three to four.

Mr. DELAY. But you are looking for three to four?

Mr. GOLDIN. Yes.

Mr. DELAY. But the administration—your part of the administration is looking for three to four options.

Why is not one of those three or four options just the scrubbing of the present design? Or could it end up being?

Mr. GOLDIN. It is conceivable we could have that. Give us a chance to give a thoughtful answer to Chairman Brown's letter.

Mr. DELAY. Is that what you think Chairman Brown's letter is, is just a scrub—the present design scrub for savings?

Mr. GOLDIN. I believe that Chairman Brown has asked that we take a very hard look to see if we could take the existing configuration and get it down. That was the intent of his letter, and we are taking a look at it. And I felt it was very proper not to just respond to it. In fact, the press had the letter almost a day before I had it. But—

Mr. DELAY. Surprise! But you said you weren't a cynic.

Thank you, Mr. Chairman.

MANAGEMENT SYSTEM

Mr. STOKES. Let me just follow up for a moment on Mr. DeLay's question with reference to the management system.

The type of management system you have described, I don't know how you can describe it as anything other than political gold plating. I think that is the best way I could explain what you described to us.

Mr. GOLDIN. I would like not to be as graphic.

Mr. STOKES. But it might also explain why we spent \$8 billion and have very little to show for it.

Mr. GOLDIN. Again, I don't want to be judgmental except to say that this is a very difficult management structure with very good people to operate it.

Mr. STOKES. Before I turn to the next set of questions, I would like for the record to be clear, there was some conversation between Mr. Mollohan and Mr. Aldrich with reference to reductions made by Congress. I would just like the record to be clear on the fact. In the last two years, Congress has appropriated \$4,175,000,000 for station, only cutting the budget request by \$100 million. And taking into consideration the \$100 million cut, it certainly, in no way, can be responsible for these slips, four, six, nine months.

I think the record ought to reflect that the \$100 million certainly can't attribute to any of that slip.

Mr. ALDRICH. Mr. Chairman, I don't remember exactly what the conversation was, but I did not intend to place responsibility for this cost growth or the slips on the Congress budget cuts

I simply was using it as one of the factors of NASA's decisions that we made coming out of restructure, and with that adjustment of the budget. With the results of our "red team and blue team" assessments last summer, we chose to reduce our budget by \$700 million beyond 1993, and now have run into difficulty not having reserves in those years. I was not trying to side-step any of the responsibility for the decisions we made or the position that we placed ourselves in.

ADVANCED SOLID ROCKET MOTOR (ASRM)

Mr. STOKES. I appreciate that. Let's now turn to the last program we have selected, the Advanced Solid Rocket Motor. The plan for this program suggests that the initial contract totaled approximately \$1,669,000,000 for the first flight calendar year 1994.

Of course, as we have indicated earlier, you could not have had a flight in 1994 without actually delivering some flight motors; isn't that correct?

Mr. ALDRICH. Yes, sir, that is correct.

Mr. STOKES. And there was no contract that was executed? There was no provision in the contract for those motors; is that correct?

Mr. ALDRICH. The initial contract and the initial budget estimate that was submitted to Congress for \$1,699,000,000 did not include flight sets and flight motors.

ASRM INCREASES

Mr. STOKES. I would appreciate it if you would run through, in more detail exactly what caused the \$795 million increase in the 1991 budget and the \$536 million increase in the 1992 budget.

Mr. ALDRICH. Well, the increase, the first one you mentioned, the \$795 million congressional budget, went from \$1.669 billion to \$2.464 billion. The primary cause for that increase was the inclusion of six development flight motors in the program and, therefore, rounding out the program with that content as well as the development costs themselves, which had only been the previous estimate.

There was also a debate that went on during the 1990 time period about whether we could find some alternative financing to do some of our Construction of Facilities work. And in fact, the final conclusion coming out of those deliberations was that the facilities' work needed to be Government funded. And so there was also \$164 million in the \$795 million to round out the dollars necessary to do the facilities, as they were known at that time. Those are the two primary causes.

However, there was also a schedule slip involved in the deliberations that went into deciding some of these facility issues and in fact, the change from calendar year 1994 first flight to end of 1995 first flight also incurred \$164 million for scheduled slippage.

So \$510 million for flight motors, the first six sets; \$164 million to round out financing for facilities; \$164 million, which is coincidence, being the same number, for schedule slips are the primary causes there. And there was—I think that total is slightly bigger than \$795 million. There were some other offsets that brought that total to \$795 million level.

Mr. STOKES. Okay.

Mr. ALDRICH. Now, let's see. You asked, then, about when we went to the 1992 congressional budget—I have a chart.

Mr. STOKES. Let me ask you this question. I guess what we don't really understand is how NASA could have set down, in fiscal year 1990 and 1991, and determined this program really needed to be at the \$2.4 billion level, and then somehow missed the \$536 million that showed up in the following fiscal year.

Mr. ALDRICH. Are you asking, again, between our initial estimate in 1991 or between 1991 and 1992. The primary causes of the growth between 1991 and 1992 had to do with the fact that when we initially contracted for the technical work for the facilities and for the motor development for this contract, we again had a specification that was not current with the known intent of what the program would include. So we had initially started a contract that needed to be definitized post-contract signing, and that definitization added \$287 million for motor development and additional facilities costs. At that time, we also added in a contingency as well to cover those cases.

So the essential growth from 1991, which was \$2,464 billion, to 1992, which was \$3,000 billion, was defining the real content required to do the facilities job and the real content required to develop the motors.

Mr. STOKES. So I guess the bottom line, is that, in terms of the \$795 million, you still just did not have it defined?

Mr. ALDRICH. With the \$795 million, we added the flight sets; but we were still debating the real, thorough technical content required to do the program. And even though we initiated the contract in May 1990, it was not until later when we submitted the FY 1992 congressional budget, in late 1991, that we, in fact, had done the bottoms up baselining and understanding of all of the content that needed to be in the contract to do those jobs.

Mr. STOKES. And that was both the facilities job underestimated as well as the technical motor development. Thank you.

Mr. Lewis.

COST OVERRUN

Mr. LEWIS. Mr. Chairman. The questions that I have relate to cost flow and cost overrun.

Your agency budget request last year deleted all of fiscal year 1993 funding. This subcommittee restored 350 million of that in conference.

So the logical question to follow is: What role, if any, did NASA's own uncertainty about ASRM play in increasing the cost from 1.4 to 3.25 million?

Mr. ALDRICH. That is the third piece. I have just described the first two to the Chairman.

Last year, we did not submit ASRM in the budget. We informed Congress that we would need \$515 million in 1993 to continue the project, although we had not submitted it. At the time that the program was restored by Congress, we received a funding level of \$360 million for 1993, and a reduced funding profile from that required

for the ensuing years. These funding reductions resulted in a cost growth of \$497 million for 1993 and beyond.

We had to slip the first launch date 22 months from early 1997 to late 1998. That accounted for \$350 million of the cost growth, and that slip caused the program to extend and incur additional costs in the order of \$350 million.

The remainder of this \$497 million is, due to better definition of the prime contract requirements, project support and integration efforts. We also reduced reserves to keep the program DDT&E costs below \$3.5 billion, money that we added in to cover that time-frame.

ASRM RESERVES

Mr. LEWIS. Okay. We talked a bit about where reserves should be built into a multi-year NASA program earlier in the hearing. One of the reasons for the cost increase in schedule slippage was an unanticipated safety requirement for a blast wall.

What was the cost of the blast wall?

And did you have sufficient reserves in 1992 when this problem first surfaced?

Mr. ALDRICH. The cost for the blast wall, which is under construction as we are talking, was \$11 million. We knew that we needed the blast wall in 1991 or we would not have priced it. And so the price of that blast wall was also included in the 1993 restructured program, which would be the basis for our 1994 budget.

Mr. LEWIS. Okay.

Thank you, Mr. Chairman.

MANAGEMENT REFORMS

Mr. STOKES. I think I have one additional question for Mr. Goldin. I have been given to understand that these reforms, which our staff was told are essentially the same, the ones that you are about to propose now, were promulgated in the Federal Register for four days in December and that they were then withdrawn.

The question I pose to you is why this happened. Apparently there were not many changes made between the December version and today's version. Would you please comment on that?

Mr. GOLDIN. Sure. Let me say the following: There were three changes which I think are substantive changes. By the way, it was limited to the fee reform; it did not cover any of the other reforms. It was just one specific element of the reforms that went into the Federal Register. I had not reviewed it before it went out; I hadn't seen it. And some on my staff were concerned that it was too broad in definition and it wasn't focused enough.

And let me give you an example of one particular issue. With regard to the payback on the award fee, there was a broad statement about how a contractor would have to give back the potential fee in case there were significant cost schedule performance problems.

The change that was made in the new approach was that we defined a set of different circumstances. One was service support contracts, to which we didn't think it applied at all. Of course, those are mostly time and materials, if you will. Then we said there

would be a difference between development contracts and production contracts. We tried to get more definitive. We felt, on a production contract, it was very applicable. On a development, cost-type contract, because we are asking people to take risks, where we would ask for the earned feedback, we felt it was very, very applicable.

But as to getting the potential fee back with a very high negative side, it would have a chilling effect on inserting new technology, and it would be self defeating. So we were very concerned that, on the development contract, we did not want to have the full value of the potential fee. And it just took time to work that through. That was probably the major circumstance. Again, because we are a technology agency, we wanted to encourage our contractors to take risks. However, we feel there should be some prudent checks and balances. So that is probably the major difference.

There is a second difference here.

Dee, can you help me out? I don't recollect the other difference.

Ms. LEE. That was mainly on the award fee portion. The other thing we did was clarify base fee. On the activity that was published in last fall, there was no base fee allowed. We have, subsequently, modified that to allow a modest base fee not to exceed 3 percent on hardware contracts. That was for the same basic rationale, we wanted to clarify the policy as it had been previously written.

Also on that, we added a feature to the base fee where if the contractor does not earn a 60 or above, they do not earn that base fee. So it lapses back into an award fee type effort there.

And then the third change we made was really an "adder." What we did was, previously there was some concern about the prompt payment of award fees to contractors after they had been evaluated and earned; and we put in a paragraph that, basically, emphasizes that those fees should be paid; an evaluation should be done promptly, and the contractor should be able to collect their provisional fee within 60 days.

And those are the three major differences.

Mr. STOKES. Are you going back to the Federal Register with these?

Mr. GOLDIN. We have it in to OFPP. And as soon as we get the approval, it is going into the Federal Register.

REQUEST FOR PROPOSALS

Mr. STOKES. As we conclude this hearing today, are there any major RFPs either about to be released, just released, incomplete or flawed, that you are uncomfortable with?

Mr. GOLDIN. You know, that is a very good question, I would like to come back and give you a written response to that.

Mr. STOKES. I appreciate that.

Mr. GOLDIN. I think that is an excellent question.

[The information follows:]

While NASA is moving forward now with the Agency's planned management and procurement reforms, the reforms will require a period of time to test and evaluate before they are fully in place. Hence, NASA will initiate many of the reforms as pilot tests to assess their effectiveness for across-the-board implementation, and make any necessary refinements. It is our expectation, at this time, that NASA's management initiatives, particularly as they pertain to advance approval of new starts by the Program Management Council (PMC) and the conduct of independent cost estimates of proposed programs, will be fully in place for new start proposals for the FY 1995 budget.

During the interim period leading toward full implementation of the management and procurement reforms, NASA has put in place a transition plan whereby the PMC will, at a minimum, authorize a review and validation of every new Research and Development program, including requirements definition and acquisition planning, the development estimate of which exceeds \$200 million. Further, we expect to incorporate features of NASA's revised incentive contracting policy in pending acquisitions. In some instances, a review of other critical efforts, or programs with total development estimates below \$200 million, may also be undertaken.

Those current FY 1993 candidate programs which will be validated by the PMC and their approximate acquisition release dates, are listed as follows:

- Tracking and Data Relay Satellite (TDRS) Replenishment (mid 1993), which would involve purchase of as many as three satellites which are functionally equivalent to the current Tracking and Data Relay Satellites; the launch vehicle is to be determined by the contractor with launch vehicle services to be provided by the Government;
- High Speed Research Propulsion Critical Components Program (mid 1993); this acquisition is to demonstrate technology readiness for critical propulsion technologies to allow U.S. industry to proceed with the design of an economically viable, environmentally acceptable High Speed Civil Transport propulsion system. The program includes design and test of key propulsion components using small-scale and large-scale models for promising candidate engine configurations. Down-selection to a single propulsion system is planned, followed by validation and evaluation of the full-scale engine system.
- Earth Observing System (EOS) Common Buy C/D, which would involve acquisition of multiple common-use EOS spacecraft to be used to fly various configurations of EOS instruments.

On March 30, NASA awarded a contract to Hughes Applied Information Systems, Inc., for the design, development, integration, maintenance and operation of the NASA Earth Observing System Data and Information System (EOSDIS) Core System (ECS). Because an extended delay and/or change in factors upon which the selection was based could have subjected the Government to significant liability and placed the entire contract in legal jeopardy, the Administrator has determined that the PMC will authorize an assessment and review of the ECS project within the next three months, in parallel with the startup activities under the ECS contract.

As part of the transition plan, it is also NASA's intent to conduct an independent cost assessment of, and establish Program Commitment Agreements for, each proposed FY 1994 new start proposal for R&D efforts, the total development estimate of which exceeds \$200 million. We will provide the Subcommittee a listing of such proposals upon release of the President's FY 1994 budget request.

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Mr. GOLDIN. I do want to say that I have some concern about contracts that are about to be awarded and already negotiated. I do have some concern about a few of those. So why don't we go back and thoughtfully respond to that, rather than me shooting from the hip, because the implications of what we are saying are very, very important. And I would like to answer it properly.

CHAIRMAN'S CLOSING REMARKS

Mr. STOKES. I appreciate that.

Let me just say as we conclude, that I think we have had a relatively long hearing today; but I think we have had a good hearing. And I think we have accomplished the purpose for which I felt we should hold this oversight hearing.

As you and I discussed the matter when we first announced we would like to hold these type of hearings, I said to you that I thought there are some problems that exist; and I think that this subcommittee has the responsibility under its oversight responsibilities to inquire personally into the problems and identify the reasons or the causes for these problems.

And then, thirdly, what type of solutions are available to the problems that we have been able to identify?

I think we have focused in on those areas today in a meaningful, substantive way. And I want to personally commend you and your associates for the candid, forthright and responsive way in which you have replied or responded to the questions we have been required to pose to you, as we are trying to accomplish the purpose for which we held these hearings today.

I think it is important to the American people that those who appropriate their taxpayer dollars also carry forth with the commensurate responsibility of oversight with reference to the taxpayer dollar. So I want to commend you for your participation in that.

Mr. Lewis, I yield to you.

Mr. LEWIS. Thank you, Mr. Chairman. Your comments are very well taken. I think we have had a worthwhile hearing.

Mr. STOKES. Thank you.

This concludes our hearings. And we are adjourned subject to the call of the Chair.

[Questions and answers for the record follow:]

Responses to written questions submitted by Cong. Torres.

NASA Cost Overruns

QUESTION 1:

In your testimony you outline a number of reform measures designed to control cost. Under the Program/Project Planning part of your Management Reforms you ask the committee to fund "future concept design studies more robustly."

Are you suggesting that providing more funds on the front-end of a project will help keep total costs down, or are you merely saying that this increase in funding will help you better calculate the total funding necessary to complete the project?

ANSWER 1:

The answer to both parts of your question is yes.

Increasing the front-end funding of a project is the single most useful action to providing a complete understanding of the work required, and thus its cost. Greater front-end funding means that requirements are more fully defined, technical complexities and challenges are better understood, schedules are more realistic, and therefore the estimated costs are much better defined.

A good project estimate provides an element of stability to the project planning and execution process. Rebaselining projects, because the initial resources requirements were understated, is a very costly process. On a large project upwards of half a year or more may be lost as contractor staff is reworking plans rather than producing hardware. Space Station Freedom is an unfortunate example of the effects of continuous rebaselining. Better initial estimates will result in a lower final cost.

QUESTION 2:

You also testify that you will be strengthening cost estimating by requiring independent estimates for major programs. As part of this reform plan you indicate that NASA's Cost and Economic Analysis Branch is actively seeking additional, qualified staff for the expected workload.

How will you achieve this? Will you reprogram existing funds for the positions or will you be seeking additional funds?

ANSWER 2:

NASA plans to advertise these positions to the widest possible audience. We expect responses from NASA and non-NASA applicants and will choose the most qualified from among these. Additional funds or FTE's required to support the anticipated staffing increase will be reallocated from within the current fund and personnel levels so that no reprogramming or increase will be needed.

QUESTION 3:

Speaking of qualified staff, what procedures do you have in place to ensure that qualified women and minorities are provided the opportunity to work at NASA?

ANSWER 3:

NASA is clearly committed to developing and implementing flexible and effective procedures and programs that will attract minorities and women into the Agency workforce. Despite hiring and budget constraints, the NASA Field Installations attend conferences and career days sponsored by organizations that direct their attention to specific minority populations or women. During FY 1992, 15,000 copies of the new NASA recruitment brochure, Mission: The Universe, were distributed nationwide. This brochure was designed to appeal to diverse student populations and features minorities and women giving convincing testimonials about their work as part of the NASA team. Also, during the last fiscal year, 1,072 (29.2 percent minority) cooperative education students were hired, including those from Historically Black Colleges and Universities, Hispanic Association of Colleges and Universities, and schools with a significant population of women.

The NASA Administrator recently sent letters to 62 culturally diverse organizations to request help in assisting NASA to further improve the multicultural diversity of our workforce, particularly career positions at the Senior Executive Service (SES) level and the mid career level of GS/GM-13 to 15. Vacancy announcements are now mailed these organizations to recruit, vacancies are advertised for six weeks. In addition, a formal Candidate Development Program (CDP) has been developed to prepare individuals for career advancement.

Positive actions to identify, recruit, hire, and advance minorities and women are inherent within our NASA culture. For example, NASA provides global visibility in the astronaut program. Of the 19 astronaut candidates selected during the last fiscal year, five were minorities and women. More specifically, three non-minority women, one Black male, and one Hispanic male were selected. Special attention was given to the recruitment of women and minorities for these very high profile, role model positions.

QUESTION 4:

Can you tell me the number and percentage of women and minorities presently working at NASA, by position? I am particularly interested in knowing the figures regarding professional staff.

ANSWER 4:

The attached chart displays the number of females and minorities in the permanent workforce as of January 23, 1993.

QUESTION 5:

In discussing procurement reform you state that under your new Incentive Contracting (Award Fee) policy, "significant financial penalties (are provided) under certain non-performance circumstances."

Could you tell me exactly what these circumstances are?

ANSWER 5:

The "non-performance" circumstances are a failure of the item to perform its function,

ANSWER 4:

	Total Population	Non Minority Female		Minority Female		Total Female		Minority Male		Total Minority	
		No.	%	No.	%	No.	%	No.	%	No.	%
Scientific & Engineering	13,471	1,586	11.8%	376	2.8%	1,962	14.6%	1,518	11.3%	1,894	14.1%
Professional Administrative	4,683	1,897	40.5%	509	10.9%	2,406	51.4%	314	6.7%	823	17.6%
Clerical Support	2,741	1,865	68.0%	796	29.0%	2,661	97.1%	32	1.2%	828	30.2%
Technical Support & Wage Grade	3,129	178	5.7%	62	2.0%	240	7.7%	449	14.3%	511	16.3%
Total	24,024	5,526	23.0%	1,743	7.3%	7,269	30.3%	2,313	9.6%	4,056	16.9%

either totally or partially, after NASA has accepted the item and placed it into service. The exact criteria would be different for each contract, as each item has a different function. However, an example would be a communications satellite required to operate in Earth orbit for three years. If the satellite failed immediately and totally upon being placed in orbit, the contractor would have to pay an amount equal to the total award fee dollars he could have earned under the contract. If there was partial performance, a schedule of contractor-to-Government payments would be negotiated; e.g., 50% for 18 months of service. On the other side, a schedule of additional incentive payments from the Government to the contractor would also be negotiated to reward the contractor if the satellite performed longer than the contract required (assuming the additional satellite performance was considered beneficial by the Government).

QUESTION 6:

A number of years ago I authored legislation, which was enacted into law (P.L. 101-37), requiring all federal agencies to impose "liquidated damages" on prime contractors that fail to make "a good faith effort" to meet their small and minority business subcontracting goals.

Has NASA ever audited subcontracting goals to ensure compliance?

ANSWER 6:

NASA has always monitored subcontracting goals and contractors' performance against their stated goals. Contracting officers perform this task as part of their contract administration responsibilities. Semiannually, contractors must submit a Standard Form 294, Subcontracting Report for Individual Contracts, which contains information regarding the goals established in the contract and the value of subcontract awards made toward achieving those goals. Each procurement office has a Small Business Specialist, whose office closely examines these reports.

In addition, we periodically conduct Contractor Procurement System Reviews (CPSRs) at our major contractors. Part of the CPSR is a review of how well the contractor systematically supports subcontracting with small and small disadvantaged businesses.

QUESTION 7:

Have "liquidated damages" or financial penalties ever been imposed for failure to comply with subcontracting goals?

ANSWER 7:

Although we have requested some contractors to explain why damages should not be applied, a satisfactory answer has always been furnished to show that the contractor was at least making a "good faith effort," and we have not assessed liquidated damages. However, we utilize incentive-fee and award-fee contract types on most of our major programs. Performance against subcontracting goals is typically included in the incentives as an element of contract administration. This allows us to review and encourage contractor performance throughout the life of the contract, rather than waiting until the end of the contract as is done with liquidated damages.

QUESTION 8:

In your testimony you state that for FY 1992 NASA awarded 7.2 percent of its total contract dollars to SDBs and that 8 percent of all contracts are expected to be awarded by FY 1994.

Could you provide me a breakdown of the type of contracts these figures represent. Specifically, I would like to know the number and percentage of contracts awarded for service projects, high technology projects, manufacturing, etc.

ANSWER 8:

The available information is provided below. These numbers include awards to small disadvantaged businesses, woman-owned small businesses, Historically Black Colleges and Universities (HBCU's), and Other Minority Institutions (OMI's). It is important to note that we can only provide this breakdown for the prime awards -- it is not possible to break down the subcontract awards into types of products and services provided. (The subcontract awards [\$491.5 million] were a larger portion of the accomplishments than the prime contract awards [\$373.6 million].) In addition, it is not possible to break down the small purchase (under \$25,000) portion (which accounts for about \$13 million of the total) into types of products and services provided.

FY92 PRIME AWARDS TO SDB's, WOMAN-OWNED SM. BUSINESS, HBCU's, & OMI's:

TYPE OF SERVICE/PRODUCT	\$Million	#
R&D	118.0	743
Professional services	56.4	61
Administrative support services	42.6	80
ADP & telecommunication services	31.7	63
Maintenance/Repair/Alteration of property	28.4	58
General purpose ADP equipment & software	20.7	62
Operation of Government-owned facilities	14.5	20
Housekeeping services	9.5	36
Photographic, mapping, printing & pub'n services	6.0	21
Construction of structure and facilities	5.2	27
Instruments and laboratory equipment	5.0	46
Management support services	4.3	9
Technical representative services	4.2	5
Metal bars, sheets and shapes	3.7	1
Maintenance/Repair/Rebuilding of equipment	1.3	20
Education and training services	1.3	5
Ship and marine equipment	1.2	1
Medical services	1.0	1
Communication, detection & coherent radiation equip.	0.7	12
Miscellaneous	5.1	79
Total SDB Prime Contract Awards	\$ 360.6	1350
Total SDB Small Purchases	\$ 13.0	
Total SDB Subcontract Awards	<u>\$ 491.5</u>	
Total FY 92 SDB Awards	\$ 865.1	
Total NASA FY 92 Obligations (excluding intra-governmental orders, grants/agreements, and awards outside the U.S.)	\$12,086.5	

QUESTION 9:

You mentioned in your response to the previous question that NASA has established an Advisory Council to help shape its policies regarding women and minority participation.

Could you please expand on this issue? Specifically, please provide me a description of the Council, including the composition of its membership, how members are selected, how often it meets and the procedures under which it operates to provide input to the Agency.

ANSWER 9:

The NASA Minority Business Resource Advisory Committee (MBRAC) was established in July 1992 by Administrator, Daniel Goldin. The purpose of the Committee is to advise NASA on how to expand its competitive base of contracts to include more small disadvantaged businesses (SDBs). It was also envisioned that the Committee would make recommendations to NASA on how the Agency could make its existing procurement initiatives work in a manner that would assure more contract awards to SDBs.

The Committee's membership consists of representatives from small disadvantaged businesses, trade associations, educational institutions and major corporations. The Committee is multiculturally diverse, consisting of African-Americans, Hispanic Americans, Asian Americans, Native Americans, non-minority women, handicapped individuals and males of all origins. The Committee is also diverse in entrepreneurial expertise and firm size.

The Chairman and Vice Chairman of the Committee are appointed by the NASA Administrator to three-year terms. The rest of the Committee is officially chosen by the Executive Secretary, who receives input and recommendations from the Committee Chairman, interested Congressional members and pertinent NASA staff persons.

The Committee is under the direct jurisdiction of NASA's Office of Small and Disadvantaged Business Utilization (OSDBU). The Associate Administrator of that office appoints the Executive Secretary of the Committee who serves in the role as a staff director. The Executive Secretary is selected from the staff of the OSDBU.

The Committee currently consists of 24 members. It is broken down into eight working groups. The Committee currently plans to meet four times per calendar year. It held its first meeting on January 26, 1993, in Washington, DC, and will hold its second meeting on April 14, 1993, at NASA's Lewis Research Center in Cleveland, Ohio. All of its meetings are public and are announced in the Federal Register. Meeting minutes are also public.

The Committee's function at each meeting is to gather facts, analyze facts and make recommendations to the NASA Administrator through the Executive Secretary.

The Office of the Administrator will then determine if such recommendations are acceptable, and if so, will direct such recommendations to be implemented within NASA's current management structure.

A list of Committee members are attached.

NAC Minority Business Resource Advisory Committee

1. Ms. Nancy F. Archuleta
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QUESTION 10:

As Chairman Stokes indicated previously, the GAO report cited "redesigns" as one of the primary reasons for cost overruns. However, despite this criticism, NASA has recently been directed to redesign the Space Station.

Does this new directive to redesign the Space Station create the potential for additional delays and cost growth?

ANSWER 10:

The Administration has directed NASA to redesign the Space Station to achieve a significant reductions in development, operations and utilization costs. NASA recognizes that the Agency's overall program must be revectorred to accommodate enhanced aeronautics and other advanced technology efforts within the Administration's FY 1994-1999 plan for civil space and aeronautics.

NASA is taking every step to prevent any inadvertent cost growth in the Space Station redesign effort. We have placed some of our top people on the team and put the resources of the entire Agency at its disposal. In addition, to take advantage of the work accomplished to date, the redesign team is analyzing the current design, system by system, to make maximum use of the work which has already been accomplished where feasible.

The fundamental program redesign groundrule is to achieve the scientific benefits of human presence in low Earth orbit at the earliest feasible date for a reduced funding level.

INDEX

	Page
Advanced solid rocket motor (ASRM)	97-99
Advanced Turbopump Program	23, 35-42, 46-48
Communication satellites, launching of	64-65
Cost analysis, independent	5, 11-12, 27-28, 41
Cost growth/overruns	1-5, 9, 23, 31, 33-34, 35-36, 39, 41-42, 48-49, 59-60, 62, 66-69, 80, 97-99
Cost reductions	55, 57-58
Explorer Program	61-62
Funding reserves	22-23, 50-52, 56, 70-71, 87, 99
Hubble space telescope	19
Management reforms	4-8, 11, 56, 99-100
Management structure, NASA	92-96
Management, program/project planning	4-5, 11, 46
Mars Observer	7, 48-49, 50-53, 59-61
National Aero-Space Plane Program	84-85
New program starts	20
Procurement:	
Award fee contracts	13-14, 19-20, 24, 64, 100
Contractor performance evaluation	6-7, 13, 15
Management	6-7, 12-17, 20-21
Small Disadvantaged Business Program	16-17, 25-27
Program cap process	44-46
Program Management Council	6-7, 11
Questions for the record	104-114
Small Disadvantaged Business Program	16-17, 25-27
Space Shuttle replacement orbiter	49-50
Space Station Freedom:	
Cost growth	71-73, 80
Cost history	69
Funding reserves	70-71, 87
Impact of NASP Program on SSF budget	84-85
Phase B definition	18-19, 79
Program management	87-88, 90-93
Restructuring/redesign	81-83, 86, 89
Work packages	73, 76-80
Staffing reductions at KSC	58
Technology development risks	29-30
Transfer Orbit Stage (TOS)	7, 63-64, 66-68
Vandenburg Air Force Base	65
Waste Collection System, Space Shuttle	5, 30-34

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